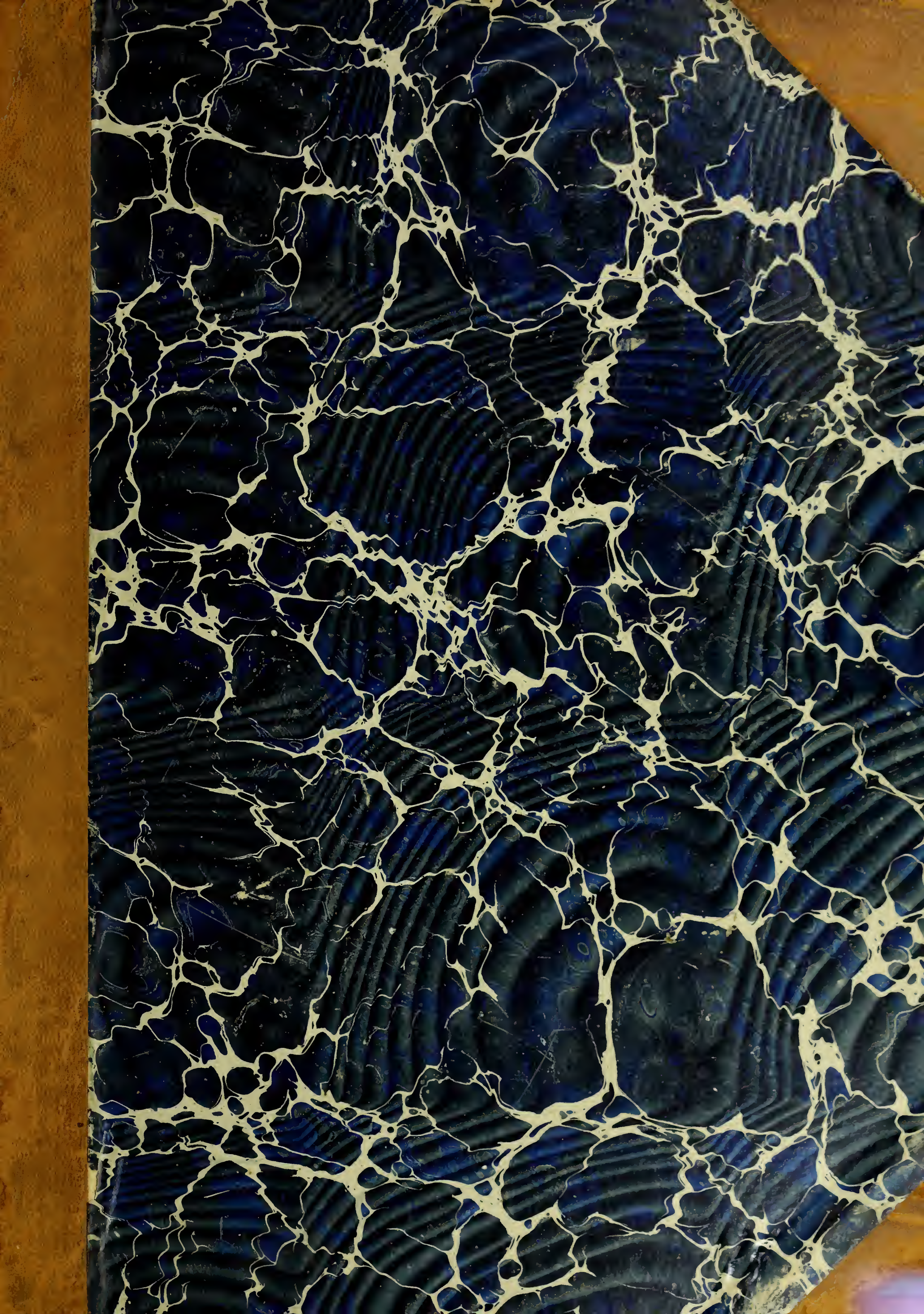

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THE ENGINEER.

DEVOTED TO

MECHANICAL ENGINEERING,

APPLIED MECHANICS,

AND THE ALLIED ARTS.

Vols. XIX. and XX.—January to December,

1890.

NEW YORK:
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET.
1890.

620.5
ENG
v.19-20

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THE ENGINEER.

NEW YORK

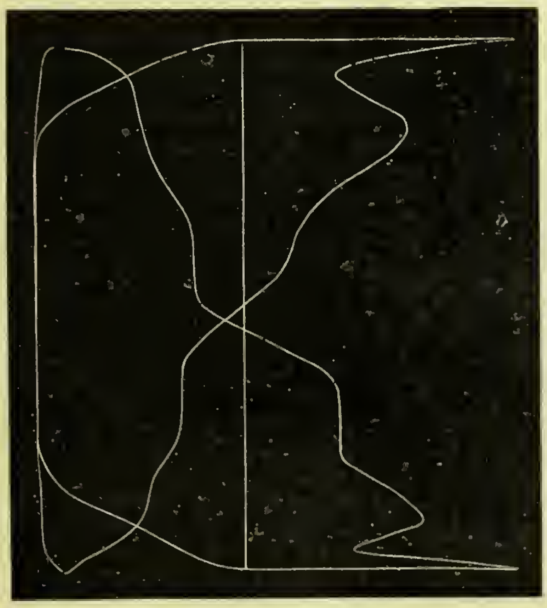
New Series, 1883, 1888. Vol. XIX. No. 1.
Ninth Year of Publication.
STEAM ENGINEERING, APPLIED

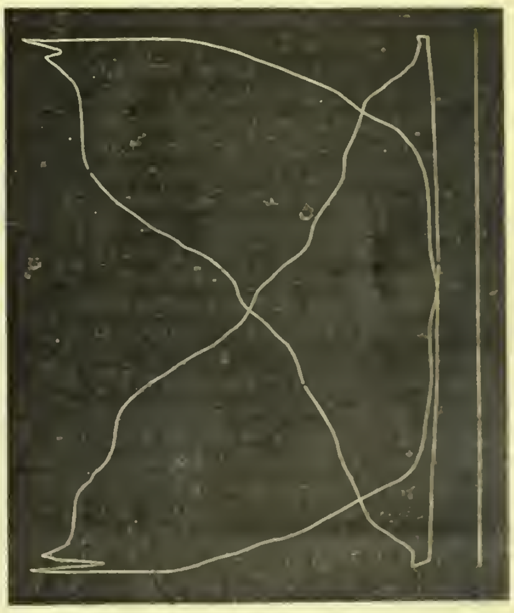
$2.00 per Annum. - Single Copies, 8 Cents.
January 4, 1890.
MECHANICS, AND THE ALLIED ARTS.

THE RICE AUTOMATIC TANDEM COMPOUND CONDENSING ENGINE.

Our engravings illustrate a new compound engine for electric lighting plant, or other service, which has been put on the market by the John I. Noye Manufacturing Co., of Buffalo, N. Y., U. S. A. There are many innovations in it, and radical departures from common practice, which are found to work with great economy, both mechanical and financial. The valve and valve motion will both repay study—the latter particularly, in that it allows of setting the valve (correcting) for aberrations while the engine is in motion. That this is an advantage will be conceded by all, for the effect of any change made can be at once noted on the cards taken, without waiting until some other time. Changes can be made promptly, of course, in other valve motions by stopping the engine, but Mr. Rice's gear is the first one we have seen to effect a change while running.

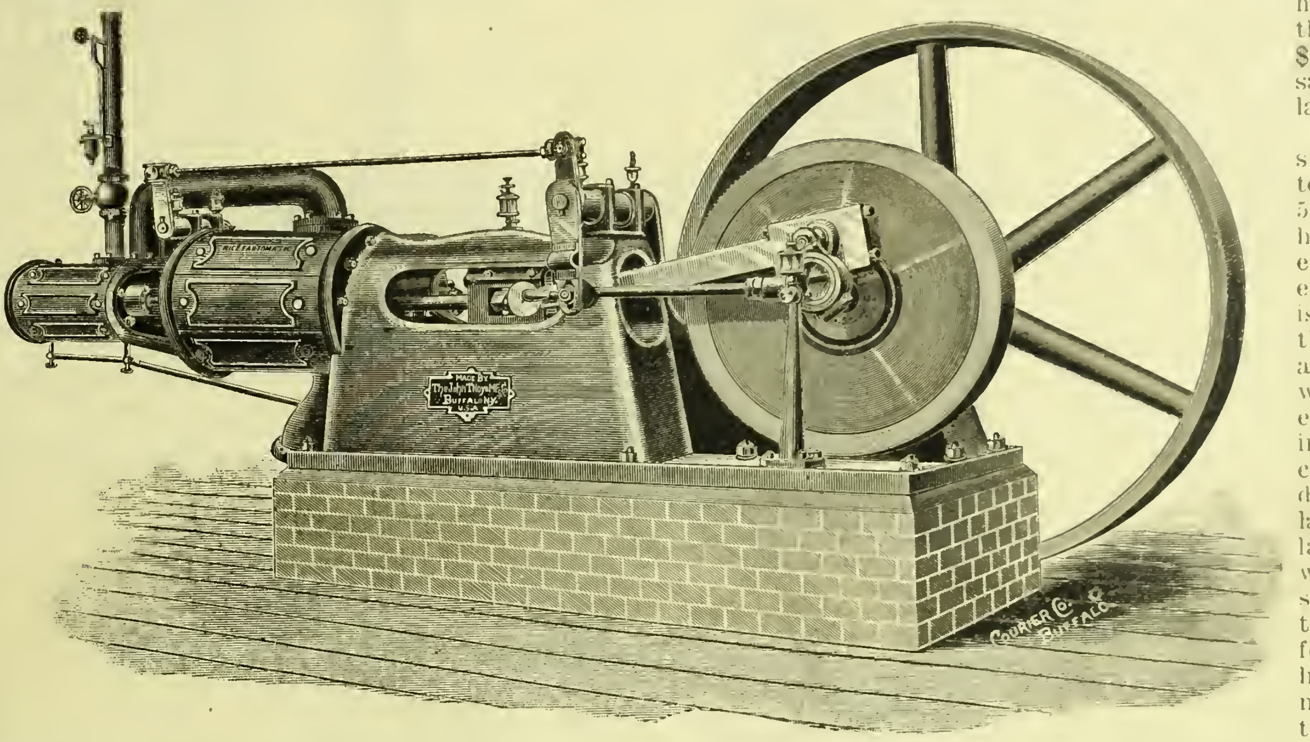
The valve itself is an ordinary gridiron valve. It is perfectly balanced from all





pressure higher than the exhaust. To illustrate, it is stated that, with a full head of steam on, both valves can be moved by the pressure of two fingers on the valve stem. The valves take steam from the inside, so they can be operated with the steam chest cover off if it is desired to ascertain whether they are tight.

The pressure plate, shown in the sectional view, is covered by Mr. Rice's patents, and forms a valve for the escape of water and for relieving over-pressure in the cylinders. It does not rest on the valve, as some might imagine from the illustration, but is supported by the two scraping shoulders on each side. The governor is inside the crank disk, as may be seen by a glance at the back view. Both high and low pressure valve are operated automatically by the governor. The lubrication of this engine has been made as nearly perfect as possible. Every oil cup is stationary, with sight feed and adjustable cut-off.



An independent pump and condenser, or a power condenser connecting direct with the engine shaft, can be used, as the purchaser may prefer. In all the plants thus far installed by the John T. Noye Manufacturing Company, the Worthington independent condenser has been used, and has given the best of satisfaction both to the user and the company. The compactness, smooth running, and thorough economy of this engine should strongly commend it to all electric light companies. Being of few and simple parts, it is durable and easily managed. Hitherto it has been used almost wholly for electric light plants, the demand in that field being so great, but its points of superiority make it also highly desirable for general use in mills and factories.

Wherever water can be obtained free in sufficient quantity it has come to pass that the compound condensing engine is a positive necessity for the economical production of power.

People are demanding more light, and they insist that it shall be cheap. Competitors for their patronage are forced by the pressure of competition to seek that system which will most economically yet efficiently serve its purpose, and in the face of this fact the more wasteful system and machine must go to the wall.

Theoretically speaking, the compound condensing engine should save one-half the fuel used by the high-pressure automatic in doing equal work. Condensation, radiation, and friction, however, bring the actual saving down to about one-third. But even at that rate the man who is paying $3 a ton for his coal will pause to reflect when shown that he might cut that down to $2. "A dollar saved is a dollar earned."

Engines of style illustrated are built of 50, 75, and 100 h.p. For larger sizes a different form of bed is used—a bed that is lower and heavier, while the governor is placed in a separate case outside the disk. Particulars of these larger engines will be given at some other time. Patterns for 100 to 500 h.p. engines are now ready in this latter form, and others will be added as the need arises. The pair of indicator diagrams shown were taken from an engine of this style, of 100 h.p., the cylinders being 9×16 and 16×16; speed, 260 revolutions. These diagrams need no special praise or explanations, since they speak strongly for themselves, and indicate to the trained eye the excellence of the valve motion. Electricians, engineers, and others who may wish to inquire further about engines built by the Noye Company, are cordially invited to write as above or visit them, when full information will be gladly furnished.

◆

Please note this is No. 1 of the volume.

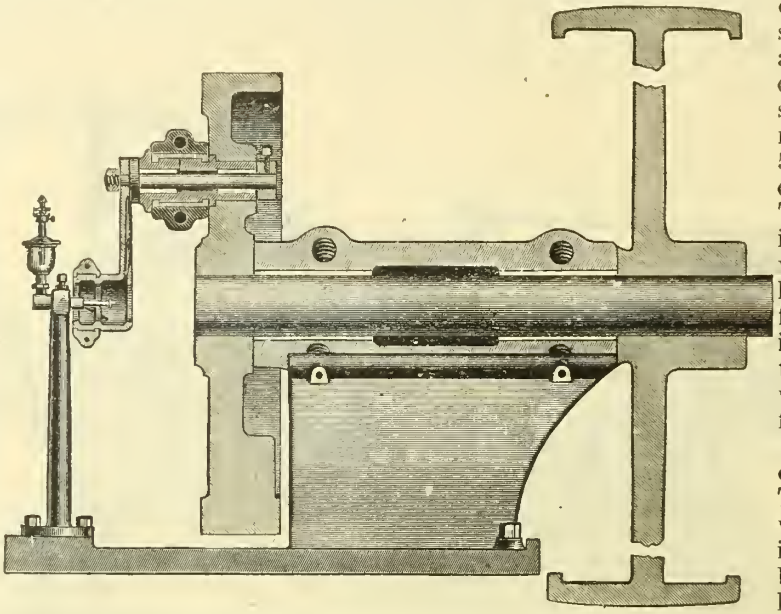
BOILER MAKING, No. 30.

By John Cook.

Inspecting Boilers.—Giving points for selecting or inspecting new boilers is a pretty hard matter, unless one knows something about boiler-making. The first thing to be done, is to find the brand, and get the tensile strength of the iron to find the safe working pressure. To obtain this, multiply the thickness of the plate in inches by one-sixth of the tensile strength, and divide by the radius (half the diameter) of boiler in inches.

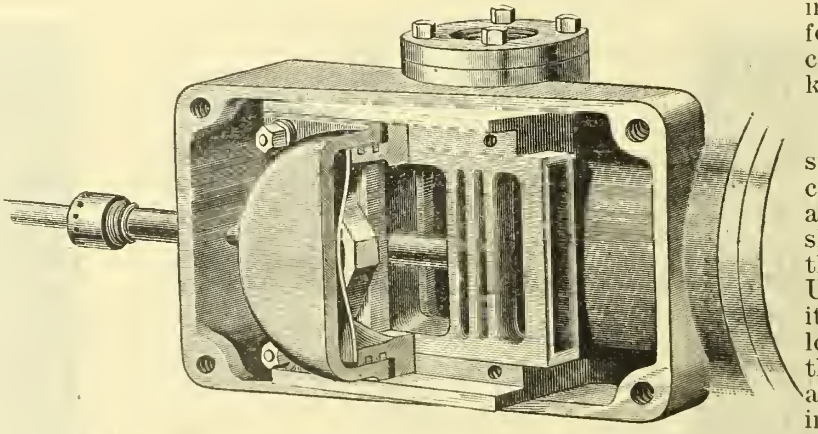
Next, look carefully over the heads to see that there are no cracks or flaws, and that the heel of flange has an easy radius; a sharp heel, or corner, leaves the head weak by reason of the material inside gathering, or checking. Look around the flange on the bottom of the dome, and see that there are no cracks there, for if they are not fitted properly they are very apt to crack when riveted. Sometimes it is hardly perceptible, especially if gone over lightly with a tool.

See that the rivet-points are equal distances apart, and not too many of them caulked. If there is a manhole in the boiler, go inside and see that all the rivet-heads are up. Look carefully at the braces, and especially to the pins in them (if there are any), also the welds. If there are tee-irons, or angle-irons across the heads, the bottom jaw of brace will generally have all the strain the braces carry. If crow-feet are used, they should be beveled to the angle of brace, whether the brace is attached to them with pins or welded to them. If the crow-feet are not beveled, the brace will be apt to pull the bottom of crow-foot away from head, when the pressure is on, thereby loosening or bursting the heads of rivets off; braces should never be bent.



When inspecting old or second-hand boilers, examine the joints carefully, or all of them that can be got at. Horizontal seams should have particular attention, both inside and out, and look well to the braces. Examine the inside corners of flanges at and just below the water-line; they are very apt to corrode there first. If the shell of boiler is not a perfect circle, the pressure will tend to make it so by forcing the smaller diameter out, and when the pressure falls, the sides will come back to their original position; thereby working on the flange and horizontal seams, or springing the seams and flanges.

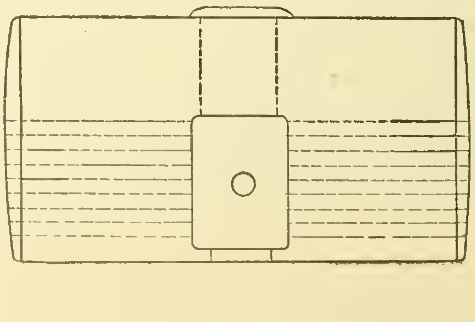
Before inspecting any old boiler it should have a thorough cleaning, so that the scale is all off the tubes and sheets; see that there are no rust-holes in either tubes or sheets. Very often the top rows of tubes are pitted more than the rest of them; if there are any such, scrape all the rust away to see how deep they go. Look carefully around hand-holes, pipes and plugs, if there are any; and if the plates are eaten away much have them reinforced by plates put on with tap-bolts and caulked.



If the boiler is of the fire-box type, look well at the bottom corners, or just over the grates, to see if they are corroded from wet ashes and leakage; also examine around the stay-bolt heads—they will often show cracks leading from the hole out, like star rays. They don't always go through the plate, but it is only a matter of time when they will, or the bolts commence to leak. This is caused by excessive firing and thick scale on the water side of plate. If there are any bulges between stay-bolts, but not serious enough to occasion cutting out, it would help considerably to have extra stay-bolts put in, for it is probable that the cause of bulging was through not having bolts enough at first, or of having carried too much pressure at some time. To find whether the stay-bolts are properly spaced, multiply the square of the thickness of plate in sixteenths by a factor and divide by the pressure; the square root of the sum is the distance the bolts should be from center to center. For a $\frac{3}{8}$ plate square the thickness, 6ths=36ths, proceed as under:

```
           36
           95
          ———
          180
         324
     ————————
120 ) 3420          28.50 ( 524
       240          25
      ————        ————————
      1020      102 ) 350
       960            204
      ————      ——————————
        60     1044 ) 4600
        60            4176
                      ————
                       424
```

For $\frac{3}{8}$th plate and with a pressure of 120 lbs., the bolts ought to be five and one-quarter inches apart. If the plates are $\frac{5}{16}$ths the bolts would have to be four and one-half inches apart. The factor for $\frac{7}{16}$ plate is 95; over $\frac{7}{16}$ the factor is 105. The bolts should be 1″ iron. The throat sheets of this class of boiler are often a great bother through the rivets leaking, and they are hard to get tight. The bead on the tube-ends should be examined carefully and the soot scraped off, as they often get burnt or broken off. If they are, they should be taken out and a piece welded on the end. In long boilers, especially, the beads break off soon, for the tubes sag in the middle, breaking the top of the bead off. I think that 12 ft. is the greatest length that a boiler ought to be, with 3″ or 3½″ tubes in it. If they are longer the tubes should have some kind of support in the center of them, and, I think, it would be a good plan to have a combustion chamber, *A*, in the center; then they could be made any length; something like this.



[Mr. Cook's suggestion is a good one, and, while original with him, is not new. The Pennsylvania ferryboat '*Baltimore*,' on the Company's ferry in this city has had a boiler so constructed for many years, and it is very satisfactory, we hear.—Eds.]

◆

NOVEL CHIMNEY.

The Dunkirk Engineering Works are building a new chimney for the Brooks Locomotive Works which differs greatly in construction from the general idea. It is 150 feet high above ground, with an average diameter of six feet. The hexagonal brick base is fourteen feet in diameter and fifteen feet high. Immediately above this is a section made of twenty-four vertical strips of tank iron twelve feet long, enclosing a space twelve feet in diameter at the beginning and gradually tapering to six and a half feet diameter at end, where begins a series of rings or short cylinders of tank iron of the same thickness as the strips. These are strongly riveted together, and compose the main portion of the shaft. The diameter of the lowest ring is 6½ feet and that of the highest 5½. There is one rivet less in the circumference of each successive ring. The chimney will terminate in a beading and swell top, constructed of vertical strips of iron, similar to the lowest section of the iron work. The foundation was begun October 1, and, if the weather continues favorable, the iron work will be finished next week, after which it will be lined with fire brick.

The chimney has been built without any scaffolding inside or out. The boiler men who are doing the work are suspended from the top in iron cages. The cages are supported by a strong wooden frame 30 feet in length, 15 feet of which rises above the shaft, and is held in place by eight chain hoists, which are fastened to angle irons riveted to each course of iron. A turn-table on the top of this frame swings the cages around the shaft, to suit the convenience of the men. The tackle for drawing up material is also attached to the wooden frame. The cages ascend as fast as the work progresses, but have not been lowered since the work began, and will not be lowered till it is finished. The men ascend and descend by ladder rounds riveted to the outside of the chimney and by a hoist inside. A speaking tube enables them to communicate easily with assistants on the ground. A stove inside the brick base furnishes comfortable heat for the men, and a pipe connected with a pan in the works keeps up a blast for the rivet fire.

◆

Professor Thurston recently stated that steam jackets are decreasing in utility as engines are advancing towards perfection, and should they ever attain this ideal, the jacket would be wholly useless. Under certain conditions even now its use might result in a decided loss. There were two periods during the stroke when the steam entered and when it left the cylinder, during which the jacket was of importance. During the first period the jacket had a beneficial effect, as it tended to reduce initial condensation. During the second period, however, its action was deleterious, as it heated the steam on its way to the condenser. The saving effected was due to the difference of these two actions.

◆

It was thought to be rather revolutionary when Congressman Thomas, an amateur, undertook to design an ironclad, but we see that worse things can happen. The N. Y. *Sun* says:

> "To replace such expensive failures as the '*Victoria*,' the *St. James' Gazette* has proposed a ship, the plans of which have created a great deal of discussion among naval men in Great Britain."

Oh, no, *Mr. Sun*, naval architects do not discuss the vagaries of amateurs.

ONLY ONCE A YEAR.

ONCE a year we have the very reprehensible practice of publishing a portion of the kind words of encouragement our friends give. We own that it gives us pleasure to do this, and we are sorry if it gives any one pain to read them. If it does they must bear in mind that it is the only time we have to show publicly the appreciation of our readers.

"I enclose, etc., for THE ENGINEER. I am not an engineer, as you will perceive if you peruse the business card at the head, but I take an interest in engineering matters and find your paper very interesting.
"GEO. H. M. BARRETT,
"Rockport, Me. *Attorney.*"

"Enclosed please find, etc., for THE ENGINEER for another year. I like your paper very much, and think it is worth ten times the cost. It is so cheap that everyone calling himself an engineer ought not to be without it. Success to you for the new year coming.
'V. H. SENNETT."
"Bucksport, Me."

"Yours covering $1 overpaid on my subscription is at hand, and am much obliged. I can hardly say how I came to make the mistake unless it was that I was thoroughly convinced that the paper was worth at the very least three dollars per annum. Wishing you continued success I remain.
"Manchester, N. H. "C. H. M."

"Am very well satisfied with your paper. I find no difficulty in getting $2 worth of information in the twenty-six issues during the year. I hope, dear sirs, that you may double your circulation for 1890.
"Philadelphia, Pa. "FRANK KELLY."

There, that is all we shall publish; and if there are any who dislike such reading matter they can give us credit for self-denial, in that we did not publish ten times as much.

* * *

THE ENGINEER, published by E. P. Watson & Son, at 150 Nassau Street, has closed another year of success, and is ready to open another volume with brighter prospects than ever. It is a paper which, to use the editor's own well-chosen phrase, "is not popular," as it appeals only to thoughtful men who wish to gain practical knowledge in a certain arbitrary direction. But it is a paper which attends strictly to its own business, and understands that business so thoroughly and appreciates it so fully that it has no time to meddle with irrelevant things and no space to devote to anything but instructive facts and statements. It is one of the most independent and reliable of the class papers published. Every manufacturer who employs an engineer could with much advantage put a copy of Mr. Watson's paper into his hands—*Elizabeth Journal.*

* * *

FERRANTI'S method of insulation is unique and original as well as new. One conductor is a metal tube, within which, and thoroughly insulated from it, is the other portion of the circuit. The outer wire or tube is buried in the ground, and the inner portion so arranged that contact with it is impossible, being covered by the outside tube at every possible point. He carries his primary current to the distribution point at a high pressure, say as high as 10,000 volts. His high-pressure dynamo is covered by an iron box, the lid of which is held down by magnetic force, and it cannot be opened by anyone without first disconnecting the circuit.

* * *

As to the fighting value of torpedo-boats, Admiral Tryon's experience is interesting. He had six, and his antagonist an equal number. These torpedo-boats were kept busy, at night particularly, and had abundant opportunity of sinking hostile ships by means of their dummy torpedoes. With one exception, possibly two, no torpedo is known to have done any constructive damage during these operations, but many torpedo-boats are known to have aimed at vessels belonging to their own side.—*Harper's Weekly.*

* * *

THE one dangerous man to the peace of communities—the fool technical writer on the daily paper.

BARNARD'S WATER AND OIL SEPARATOR.

THE engravings show Barnard's Improved Separator for removing entrained or condensed water from live steam, and condensed water, oil, etc., from exhaust steam. Separators are rapidly becoming better known and appreciated; long steam pipes, oftentimes uncovered, necessarily condense considerable steam; boilers frequently prime and carry more or less water along with the steam. No matter what causes water in live steam pipes the fact that it is there is a sufficient reason for removing it before the steam reaches the engine. Entrained water is an absorbent of heat; it is incapable of performing work in the cylinder, and very liable to wreck an engine or pump. A good separator furnishes practically dry steam, that is, saturated steam without entrained water, and the value of dry steam is fully appreciated by engineers, if not by coal dealers.

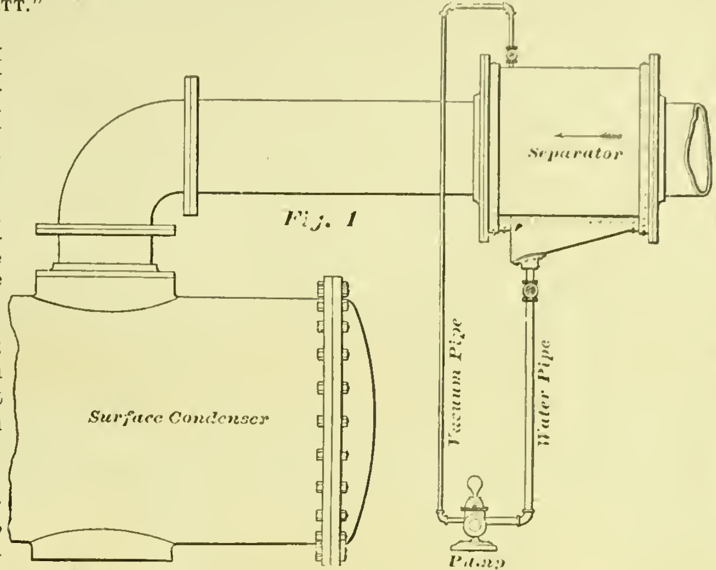


Fig. 1

By separating the oil or grease from the exhaust steam, which, after condensation (either in a surface condenser or steam heating coils), is used for boiler-feed, the greatest source of expense and labor attending the care and efficiency of boilers is removed. The effect on surface condensers, vacuum pans, feed-water heaters, steam heating pipes, etc., is equally beneficial, as the purified steam does not coat surfaces or lead to formation of dirt or scale.

This separator presents a very large and effectual separating surface, together with a liberal port area for the unobstructed passage of steam through the plates, considerably in excess of the area of the connecting pipes. It consists of a cylindrical shell of cast-iron for the smaller sizes, and of plate iron or steel for the larger sizes, fitted with a sloping channel way, open to the shell. The baffle plates are set at an angle, and are supported by rings fitting the shell. The plates of one ring cover the ports of the next, thus compelling the steam to take a tortuous course through the shell. The oil or water, coming in contact with the bars and rings, runs down through cored holes at the bottom of the bars into the sloping pocket to the discharge pipe at bottom, where it is drained off. (See figs. 2, 3 and 4.) For use on vertical pipes a different arrangement of rings and plates is used from those shown. The effect is practically the same, but, all things considered, horizontal separators are generally to be preferred.

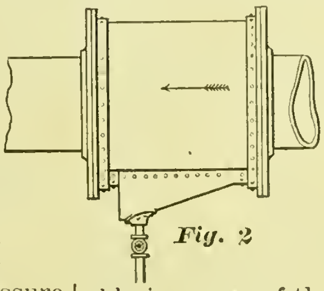


Fig. 2

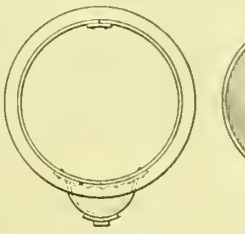


Fig. 3

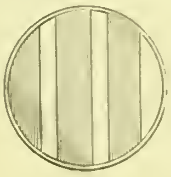


Fig. 4

Fig. 1 shows a special device that will interest engineers and others using surface condensers. It is well known that the vacuum extending from the condenser to the engine cylinder, will "hold up" the condensed water and oil collected by a separator; in fact, a separator ordinarily used under such conditions is practically useless. The device shown consists in connecting the waste pipe from the separator to the suction chamber of a pump, and in connecting a second, or vacuum pipe, fitted with suitable check valves, to the suction chamber, above the suction valves. This places the suction valves of the pump in equilibrium, and enables the pump to continuously draw off the oil and water. The efficiency of this separating device is such that no filtering tank is needed, other than the ordinary hot-well, which may be of limited capacity, sufficient to afford solid water for the boiler feed pumps to draw on. When the separator is used on live steam pipes, the estopped water should be returned directly to the boilers as a matter of economy. The conditions of each plant will determine the best method to be employed for so returning the hot water. When used on exhaust pipes of non-condensing engines, the condensed water and oil may be delivered into a tank if it is desirable to save and filter the oil for further use; if not, then it may be discharged into a sewer, or otherwise disposed of. The patentee and manufacturer is Geo. A. Barnard, No. 15 Cortlandt Street, New York City.

* * *

FOR a voyage of given length the coal consumption varies as the horsepower directly and the time directly or the velocity inversely, so that the coal consumption in the two steamers is as a^3 to 1, that is, as the tonnage; so that the cost of fuel per ton of cargo is the same for the same voyage in the two steamers; but the larger steamer can earn more money in a given time by reason of her greater speed.

If the grate area is designed to vary as the horse-power, the larger steamer requires more grate area in proportion to her size in the ratio of $a^{3\frac{1}{2}}$ to 1, instead of a^2 to 1, as in geometrical similarity; while the volume of steam required is greater in the ratio of $a^{2\frac{1}{2}}$ to 1, and at a pressure greater in the ratio of a to 1. With similar engines, the scale of size of the boilers must be considerably increased in the larger steamer; and in recent cases of disappointment in expected speed of large steamers, the cause can generally be traced to insufficient boiler power. —*A. C. Greenhill.*

* * *

A PAINTER received an electric shock recently under novel conditions. A leaky gas pipe caught fire and set fire to some electric light wires near it, melting off the insulation, in turn communicating the blaze to the surrounding woodwork. At this point a painter dashed a bucket of water on the burning matter, but received as a reminder that he was dealing with electric fluid, a smart shock from the current running back along the water to his hands.

* * *

LIFE on board a torpedo boat is one beside which that of a stoker on an Atlantic liner is luxury. The boat is under water or in blinding spray so largely that life on deck can only be endured for short periods; while below the heat is so intense men cannot sleep, and rapidly lose strength. Three days is more than enough to use up men on a torpedo-boat if the service is continual; and the officers' lot is very little better.—*Harper's Weekly.*

* * *

THE main feed pipe connected with the boilers of the Heat, Light and Power Company at St. George burst. At the works it was said it would take several days to make repairs. That is a long time to repair a feed pipe.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

TO DELEGATES TO THE NATIONAL CONVENTION OF THE MARINE ENGINEERS' BENEFICIAL ASSOCIATION.

THROUGH the courtesy of the Central Traffic Association, the Trunk Line Association, and Southern Passenger Association, persons attending the meeting of the National Marine Engineers' Beneficial Association, to be held at Charleston, S. C., commencing Jan. 20, 1890, will be granted a reduction in their return railroad fare only, under the following circumstances and conditions:

FIRST.—Each person must purchase (not more than three days prior to the date of the meeting nor later than three days after the commencement of the meeting) a first-class ticket (either unlimited or limited) to the place of meeting, for which he will pay the regular tariff fare, and upon request the ticket agent will issue to him a certificate of such purchase, properly filled up and signed by said ticket agent.

SECOND.—If through tickets cannot be procured at the starting point, the person will purchase to the nearest point where such through tickets can be obtained, and there re-purchase through to place of meeting, requesting a certificate properly filled out by the agent at the point where re-purchase is made.

THIRD.—Tickets for the return journey will be sold by the ticket agents at the place of meeting at one-third the highest limited fare, only to those holding certificates signed by the ticket agent at point where through ticket to the place of meeting was purchased, and countersigned by the National Secretary of the Association, certifying that the holder has been in attendance upon the convention.

FOURTH.—It is absolutely necessary that a certificate be procured, as it indicates that full fare has been paid for the going journey, and that the person is therefore entitled to the excursion fare returning. It will also determine the route via which the ticket for return journey should be sold, and *without it no reduction will be made*, as the rule of the Association is that "No refund of fare can be expected because of failure of the parties to obtain certificates."

FIFTH.—Tickets for return journey will be furnished only on certificates procured not more than *three days* before the meeting assembles nor later than *three days* after the commencement of the meeting, and will be available for continuous passage only; no stop-over privileges being allowed on tickets sold at less than full fares. Certificates will not be honored unless presented within *three days* after the date of adjournment of the convention.

SIXTH.—Ticket agents will be instructed that excursion fares will not be available unless the holders of certificates are properly identified, as above described, by the secretary, on the certificate; which identification includes the statement that one hundred or more persons, who have purchased full fare tickets for the going passage, and hold properly receipted certificates, have been in attendance at the meeting.

The certificates are not transferable, and the signature affixed at the starting point, compared to the signature to the receipt, will enable the ticket-agent to detect any attempted transfer.

N. B.—Please read carefully the above instructions, be particular to have the certificates properly filled and certified by the railroad agent from whom you purchase your going ticket to the place of meeting, as the reduction on return will apply only to the point at which such through ticket was purchased.

The boundary line of the Central Traffic Association embraces all that territory east of the Mississippi and north of the Ohio River, and west of Toronto, Buffalo, Pittsburg, excepting the States of Michigan and Wisconsin.

The Trunk Line territory embraces the country east of the Central Traffic Association, including New York, Pennsylvania, New Jersey, Maryland, and Delaware.

The Southern Association territory embraces the country south of the Ohio and east of the Mississippi Rivers.

For further information address the undersigned.

JAMES HENRY HARRIS,
National Secretary.
82 Madison Street, Chicago, Ill.

◆

LIFT OF SAFETY VALVES.

Editors ENGINEER:

I have only one objection to make to the paper and that is, it ought to be weekly instead of a semi-monthly paper.

As you invite questions from subscribers allow me to ask one:

What amount of lift must be given a safety valve $3\frac{1}{2}$ in. diam. having a seat with an angle of 45° to the center line of its axis, and a depth of .08 to produce an area of opening equal to that of the valve?

Pa. R. E. B.

[No hard and fast rule can be given for the lift of a safety valve, for the conditions are so varied as to angles and depths of seats that no rule as to the lift will apply to all. A rule which is used by R. H. Buell, a well-known engineer of this city, is as follows. For 45′ bevel:

1. *Multiply diameter of valve by the lift, and this product by the number 2.22.*
2. *Multiply the square of the lift by the number 1.11. Add these two products and the answer is the area of the opening of the valve.*

From this it is easy to see that we may assume any lift until we arrive at the area of the opening, but it is not essential that this last should be equal to the area of the valve chamber, and excessive lifts are difficult to get with the long lever in general use. Safety valves are intended to relieve pressure, not to blow off the entire contents of the boiler as soon as possible.]

◆

WATER TUBE MARINE BOILERS.

Editors ENGINEER:

We have lately received orders for 800 horse-power of our boilers for the steam yacht '*Tillie*,' belonging to Com. Wm. H. Starbuck, who has taken out the boilers he tried last year. We have also received an order from Mr. J. B. Wolfe for 650 horse-power of boilers for the '*Radha*' in place of the boiler formerly used, which we are to remove; also an order for a 100 horse-power boiler from Painter Bros., Pittsburg; also an order for 300 horse-power boiler from the Fulton Iron and Engine Works, of Detroit, for Congressman McMillan's yacht '*Idler*.' We have also received orders for two 150 horse-power boilers from the Gas Engine and Power Co., one of which is to go in the yacht they are to build for Mr. Rockfeller, president of the Standard Oil Co. Also an order for a 150 horse-power boiler from Mr. J. Frederic Tams, for the new sidewheel steel yacht built by Piepgrass, of City Island; also an order from Mr. H. J. Gielow, C. E., for a 300 horse power boiler for a yacht he is designing for New York parties; besides orders for some 2,000 horse-power in small boilers for various launches and small steam yachts.

We shall probably be obliged to refuse orders after about Jan. 15, for Spring delivery; so if any of yonr readers desire our boilers for the ensuing year they had better send in at once.

E. E. ROBERTS.

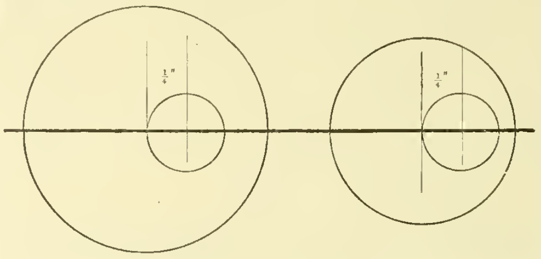
◆

LARGE AND SMALL ECCENTRICS.

Editors ENGINEER:

As I am a constant reader of your paper I would like to ask a question through it, as there are some of us here that do not see the matter alike. I have an eccentric with 3-in. throw. Now, if I turn down the eccentric $\frac{1}{4}$ inch all around, and fit straps to it, can the valve be made to travel the same distance? If so, explain, and if not, why not?

Owassa, Mich. G. G. BLAKE.



[The size of an eccentric has no connection with its throw. It may be 10 feet in diameter and have only one-eighth of an inch throw, or one foot in diameter, and have 3″ throw. The throw of an eccentric is the distance from the center of the shaft it is on to the center of the eccentric wheel itself. See diagram; both of these wheels have the same throw, but one of them is materially larger than the other. Turning an eccentric down has no effect on its throw. —EDS.]

◆

NATIONAL MARINE ENGINEERS' BENEFICIAL ASSOCIATION.

To the Order wherever found, greeting: You are hereby officially informed that National President Boyes has just instituted Subordinate Association No. 75, at Alexandria Bay, New York, the following officers being elected and installed: Wellington Willex, Past President; Wm. T. Bascom, President; Harmonious Visger, Vice-President; Albert Houghton, Recording Secretary; Arthur J. Thompson, Fin. and Cor. Secretary; Alonzo Elmore, Treasurer; Wm. Hemingway, Chaplain; Edwin Keeler, Conductor; Chas. W. Davis, Doorkeeper; John D. Carter, W. Willex, Edwin Keeler, Trustees.

The address of the Corresponding Secretary is Arthur J. Thompson, Alexandria Bay, N. Y.

The National President expresses the desire that the several corresponding secretaries transmit letters of congratulation to the Sister Association that has just united with us.

By order of the National President, fraternally, in Unity and Friendship,

JAMES HENRY HARRIS,
National Secretary.

◆

LET US HAVE A STANDARD.

Editors ENGINEER:

I would like to see a standard of sizes on water glass fixtures and rubber gaskets for the same. In the plant where I am employed we have over fifty glasses, and every time one breaks one must pare down the rubber gaskets on some to less than half the thickness. I often find glasses that will on outside diameter vary nearly an eighth of an inch.

Call a convention, Mr. Editor!

Hammond, Ind. OLD WHITE HEAD.

◆

INFORMATION FOR ALL.

Editors ENGINEER:

Can you inform me where the book "The Professor in the Machine Shop," can be had? My husband was very much interested in the letters as they appeared in *The Mechanical Engineer*. and I would like to get the bound volume of them. Please let me know.

MRS. J. E. COOPER,
3,911 Linwood Street.
West Philadelphia.

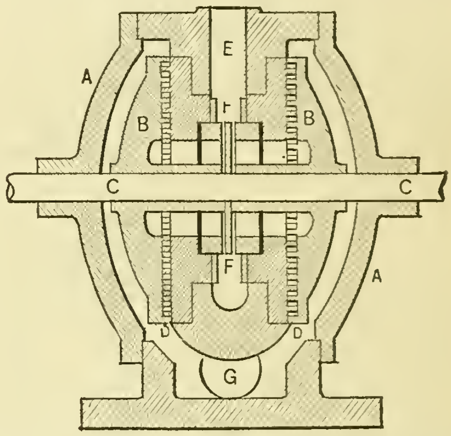
["The Professor in the Machine Shop" sold to the extent of about 500 copies, bound. The demand was not considered sufficient to carry out another volume.—EDS.]

◆

STEAM TURBINE.

THE steam turbine shown in the annexed figure is the joint invention of J. H. Dow and H. H. Dow, of Cleveland, Ohio. *A A* represents the casing, or stationary part of the engine; *BB* the rotating wheel firmly secured to the shaft *C*, and containing the buckets or floats shown in the section *D D*, which are arranged in concentric circles: and concentric with these and between them are rings projecting from the stationary part of the engine through which are cut steam passages or guides. Steam entering through the stationary part at *E*, passes both sides of the rotating disk *F F*, into the annular cavity near the center, thence outward through passages in the annular spaces between the buckets, and through the buckets, finally escaping at the outer circumference at *D*, and is conducted away at the exhaust at *G*.

It is balanced laterally by means of the disk *FF*, which is firmly secured to the shaft *C;* so that if there be a lateral movement, however small, the space on one side of the disk will be reduced and on the other side enlarged, so that the increased amount of steam entering the latter will force it back to its normal position. It is claimed that this movement may be limited to 0.02 of an inch. The energy of the steam is gradually absorbed by the wheel as it passes through it, thereby diminishing its pressure and causing expansion, similar to that in a multiple-expansion engine, there being six compoundings in this wheel.



An engine made by the Messrs. Dow had turbine wheels $5\frac{5}{8}$ inches in diameter; shaft, $\frac{5}{8}$ inch diameter; depth of buckets, $\frac{3}{16}$ inch; depth of guides also $\frac{3}{16}$ inch; weight of moving parts, 7 pounds 7 ounces; weight, including casing, 68 pounds; highest measured speed with 70 pounds steam, 35,000 revolutions per minute; so that the velocity of the circumference was nearly nine miles per minute.

An approximate computation of its regular daily performance at 70 pounds pressure gave about nine horse-power with about 60 pounds of steam per horse power per hour, the speed being about 25,000 revolutions per minute. Accurate measurements will doubtless modify these results.—*Wood's Thermodynamics, Heat Engines and Refrigerating Machines.*

◆

THIS issue is sent to a good many whose time expired on December 31, but it will not be repeated, and is only that they may not miss an issue in case they intend renewing at once. All subscriptions are in advance.

A COURSE OF READING FOR STUDENTS IN ENGINEERING.—NO. 2.

We briefly alluded to the matter in No. 12, last volume, and continue the list in this issue. Prices of works will be given on application.

Chemical Physics; Vol. III. Miller's Chemistry.

No better treatise can be found upon the subject. The matter is made exceedingly plain, and is exceedingly well handled.

Handbuch der Chemie. Gmelin-Kraut.

A standard work; contains the record and history of the different discoveries in analytical and synthetical chemistry—with reference to the journals, etc., containing the papers in full.

A Treatise on Tooth Gearing. J. H. Cromwell.

Rules and formulas for designing the various kinds of gears in general use are given in convenient form, and their application is illustrated by numerous examples.

Theory of Heat, Clausius (Translated by Browne).

This is a systematic development of the mechanical theory of heat and a brief application to the steam-engine. It is thoroughly mathematical. It also contains some of the author's discussions upon the theory of heat, and the effect supposed to follow from the concentration of rays of heat, Pg. 376.

Theorie Mecanique de la Chaleur. Zeuner.

This work was originally written in German, but was soon after, in 1869, translated into French. It is a systematic and excellent treatise of the subject. The numerous tables at the end have recently been published in Du Bois' translation of Rontgen's Thermodynamics, Pg. 585.

Electrical Illumination. James Dredge.

Two large folio volumes. The most extensive treatise on the subject named. Especially valuable for its abstracts of patents in the history of the art.

Dynamo Electric Machinery. Sylvanus Thompson.

An excellent and compact treatise on the subject named.

Principles of Mechanism. Robert Willis.

Machinery and Millwork. W. J. M. Rankine.

This book contains a summary of the principles of mechanism covering practical rules for the designs of gear teeth and of all ordinary kinds of connections, such as belting, universal joints, differential trains, etc. Also the best published digest of the principles of dynamometers and steam-engine and water wheel governors; also a digest of the estimation of the efficiency of machines or the determination of what is called the modulus of machines in Mosely's Mechanics of Engineering; also a summary of the fundamental principles of the strength of materials with an application to the principal problems of millwork, and also a brief account of the principles of cutting tools. No other English work covers its ground better, and none equals it in comprehensiveness.

The Steam Engine and Steam Boiler. 2 Vols. Professor Chas. Smith.

These books give the most complete summary of miscellaneous engine and boiler tests, in tabulated form, made previous to 1880. They also give the most extensive account, in English, of the series of the measurements of the economy of engines—compound versus single—made by Hirn and Hallauer.

Theoretical and Practical Ship-Building. W. J. M. Rankine.

The most comprehensive treatment of the principles of mechanics involved in the design and propulsion of ships; no other work on this subject approximates to it in completeness of treatment.

Traité de Chaleur. E. Péclet.

This treatise is the standard of measurements upon all phenomena connected with radiation, conduction, and convection of heat in the application of the latter to practical and domestic purposes, such as the heating and ventilation of buildings, draught of chimneys, etc. All modern writers on these subjects quote largely from Péclet, and no one has experimented in these lines as extensively as did this author.

A Practical Treatise on Heat. Thomas Box.

The most useful compendium of the laws governing the application of heat for purposes of heating and ventilation, each step being illustrated by examples taken directly from practice. The laws of the flow of steam through pipes, comparative advantages of ventilation by different systems, comparative advantages of heating by hot air versus steam, versus hot water, etc., are all forcibly illustrated by numerical examples.

Manual of Marine Engineering. A. E. Seaton.

A brief summary of the principal facts regarding the construction and management of marine engines; undoubtedly the best text-book for giving to the student the greatest amount of general engineering information on the subject in the least possible space.

—*Stevens Indicator.*

CONDENSATION IN STEAM CYLINDERS.*

The quantities of heat have also been measured separately for each of these two heat periods, by leaving the apparatus open to the engine cylinder only during a series of steam strokes, and shut during all the exhaust strokes. Thus it can be kept open for any length of time to all steam strokes only, or to all exhaust strokes only, and the cooling of the little walls exposed only to the condenser measured in thermal units. The experiments give considerable cooling to the condenser for combined as well as for exhaust strokes alone.

The effects of condensation and re-evaporation for combined strokes are clearly visible on the metal walls of the apparatus for different temperatures of the latter. When the walls are relatively cold, the drops are larger, and evaporation from them slower; when hotter, they are smaller and evaporation quicker. When the walls are hotter than the initial temperature of the entering steam, no mist or dew is visible.

Supposing the case of the walls of an actual steam engine cylinder, having a certain temperature in a hole, say, 1 millimetre from its inner cast-iron walls. The apparatus attached to it, also provided with cast-iron walls, can be kept at this same temperature (taken in the same way and at same depth), and the number of thermal units per minute per square foot necessary to obtain this result can be ascertained. In some cases heat is put into the walls and water, in others it is taken from them, depending on the temperature the walls are kept.

The iron walls of the apparatus can be steam jacketed or not, at will, like a steam cylinder.—*Engineering.*

◆

THE NEW TORPEDO BOAT 'CUSHING,' U. S. N.

The '*Cushing*' has been constructed for the purpose of discharging automobile torpedoes, those carrying their own propelling power, while she is traveling at a high rate of speed. Commander G. A. Converse, U. S. N., has charge of her construction. She is 138 feet long, 15 feet wide, 10 feet deep, and draws 4 feet 4 inches. Her displacement is about 100 tons. Speed has been the prime object in her construction, and it will be liberally paid for. The '*Cushing*' is required by contract to make twenty-two knots an hour. For every fourth of a mile above twenty-three knots per hour there is a bonus of $1,500, and for every quarter of a knot above twenty-four knots an hour a bonus of $2,000. The hull of the '*Cushing*' is divided into eleven water-tight compartments. She will carry 35 tons of coal, and will have a coal endurance at maximum speed of 3,000 knots. The hull is built throughout of steel plates.

Above the water line the '*Cushing*' will show only two conning towers and two smokestacks. A whaleback runs from the forward conning tower to the bow. The whole deck is of steel, and curved so as to deflect shot.

The two Thornycroft water tube boilers were built by the Continental Iron Works of Brooklyn, N. Y., and are the first of the kind constructed in this country. Each boiler has thirty-four feet of grate surface, 1,800 feet of heating surface, and two miles of steel tubing. The fire rooms are arranged on the closed stoke hold principle. They will be closed nearly air tight, and an efficient fan blower will force air down from an opening in the deck. The coal bunker protecting the engine will be drawn upon only after the others have been cleaned out.

The main engines are two sets of 5-cylinder quadruple expansion engines of 800 h.p., and there will be a total of twenty-eight steam cylinders on board. The high-pressure cylinders are $11\frac{1}{4}$ inches in diameter; the first intermediate 16 inches, second intermediate 22 inches, and low pressure 22 inches. The stroke is 15 inches. The main shafts are $5\frac{1}{2}$ inches in diameter, 61 feet long, are of forged steel, and will carry twin propellers of manganese bronze 4 feet 2 inches in diameter, with 8 feet pitch. A reducing valve will allow the use of direct steam at starting.

The conning towers are of one-quarter inch steel, with double sliding doors, arranged so that one, if injured in action, can be substituted for another. The towers are lighted by bull's-eyes, and their domed tops may be elevated by screws so that four inch clear space about the horizon may be had. Both towers are fitted with steering apparatus, engine room, telegraph, and with voice tubes connecting the two towers. The command will be in the forward tower until that is disabled, and will then be transferred to the after tower, where every movement made from the first has been duplicated by mechanical appliances. The forward tower has a steam tiller that will throw the helm from hard-a-port to hard-a-starboard in three and a half seconds, or before the vessel can travel her length at full speed. One engine may be run at full speed, and the other reversed at full speed. The rudder ropes are of wire.

The automobile torpedoes will be fired at a speed of 40 feet per second, while the '*Cushing*' is traveling 38 feet in the same time. They will be discharged by an explosive compound. The two bow torpedo tubes are placed under the whaleback at an angle of three degrees with the horizon. They are 14 feet long and 14 inches in diameter. The '*Cushing*' will also carry other torpedo tubes and rapid-fire guns mounted on deck.

It is expected that the vessel will be ventilated when in action by connecting the compartments with the outer jacket of the smokestack. The decklights are so arranged that they may be darkened when in action at night. The ship will be lighted by electricity.

If the present winter is an open one it is likely that the '*Cushing*' will be launched at once, and will be immediately subjected to her speed trials on Narragansett Bay. —*N. Y. Sun.*

◆

CHARLES WINTER.

We were pained to learned on the 30th ult. of the death of Charles Winter, an old marine engineer of this city. Mr. Winter died at his home 168 So. Third St., Brooklyn, N. Y., in the 58th year of his age; the cause of his death was pneumonia. Charles Winter was faithful in all the relations of life. No one ever reposed trust in him to their loss, and it is a pleasure to us personally to be able to say that the friendship which began when we were boys together at the Morgan Iron Works has never been suffered to lapse. Mr. Winter has held many positions of trust and responsibility with large houses in the trade, and he will be missed among a very large circle of acquaintance.

◆

The *Marine Journal*, New York, under the control of Captain George M. Norton, an able navigator, sometime captain of steamers out of this port, has covered itself with glory this year by its able defense of the rights of American sailors and shipowners, and by manfully battling against shams and humbugs wherever found. Captain Norton is a sincere, earnest man, who, when he starts on a voyage, heads the ship on her course and never leaves her until she makes safe harbor. Engineers come in for his good word also, and he does them a power of good by words in due season. We cannot have too many friends in this world, and Captain Norton deserves the support of all.

◆

The best and only practical training school for a young man, if he desires to become a competent machinist, is a first-class machine shop, under the instruction of a competent and conscientious foreman. There, and there only, will he become acquainted with that every day practice that will be of use to him in after-life.

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* Concluded from last issue.

THE ENGINEER.

FORTNIGHTLY. - - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, JAN. 4, 1890. No. 1.

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Entered at the New York Post Office as Second Class Matter.

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WHAT IS EDUCATION?

A TERM commonly used to signify that a person possesses certain knowledge is "education," but it is so frequently misapplied that it really has no meaning. The dictionary says that education means "the cultivation of the moral, intellectual and physical powers," but this is not wholly satisfactory, and leaves much to be desired, for many so-called educated persons have no moral faculties whatever, and their physical prowess is, as one might say, impaired. Therefore they do not come up to the dictionary standard of educated persons. In general the word is applied to persons who have gone through a collegiate course, but some of us have knowledge of such persons who have not profited thereby. They have taken degrees in foot ball and boat rowing, and their physical education is certainly complete, but these individuals seem to be deficient in mental prowess.

To our mind the educated man is one who cultivates his brain in any department to a high degree of intelligence, regardless of whether he has ever seen a college. A skilled engineer is an educated man; he may not be able to cross *Pons Asinorum*, or know aught of his mother tongue other than to express himself clearly, all the same he is highly educated in his special branch. He is distinctly this, for, while the college professor knows nothing except what his books teach him and passes for a man of education, the skilled engineer knows what the books tell him and has his own observations to supplement it.

In this light he is a highly educated man and entitled to all the honor the word conveys. The *American Machinist*, referring to the same subject, says:

> The daily papers a few days ago contained an account of a man who, after vainly trying to obtain work for ten months, became despondent and took carbolic acid to end his troubles. He was an educated man, speaking several languages, yet could find nothing to do. As time goes on it becomes less and less possible for men to get a living by virtue of having what is called an education. There are not too many educated men, but there are too many so unfortunate as to expect to get a living by virtue of having an education. A college education is an excellent thing to have, but between that and knowing how to do something that other people want done there is no comparison.

Quite so, and it would seem that the unfortunate in question was not even educated to "bear the ills he knew, rather than fly to others he knew not of."

◆

BY DEAD RECKONING.

WHEN a captain cannot "get the sun" for days at a time he has to make out his course by dead reckoning, as it is called, counting from the last observation he obtained. This may bring him all right and it may not. Winds, tides, currents, drift, many things tend to throw him out, and he can only make allowance for them. If he steers clear of bad spots on the bottom of the ocean and does not fetch up in Portugal, say, when he meant to go to Gibraltar, he feels glad and thanks his good fortune if he comes safe into port.

Steering a paper is very much like sailing a ship from one port to another, for the captain of the paper seldom if ever gets the sun. The course is always more or less obscured. No one tells him whether he is all right or not until the end of the year, and the way they tell him then is by not saying anything. They do not renew, and this silence on the part of the passengers (or subscribers) is so intense that it is not extravagant to say that it is felt. Editors cannot write to their constituents and ask them how they like the conduct of the paper, and the only way an editor can hope to bring his ship safe home is by dead reckoning. If he is a good guesser as to the drift of his audience's opinions he hits the dock square; if he is a poor guesser he never gets to the dock at all—he goes down in mid-sea. It is unfortunate for captains of papers that there are rocks right alongside the dock; one unfortunate or ill-timed article just at the close of the year may irritate a large number of persons, and not only alienate them, but a great many others who might be subscribers but are warned off by aggrieved readers. It is gratifying to observe in connection with this subject that year after year THE ENGINEER comes right up to the dock, makes fast and gets ready for another trip, and that at the present writing she is a sound A1 craft, owned and sailed by the owners.

◆

MORE HELP IN THE ENGINE ROOM WANTED.

IN our last issue a brief paragraph recited the fact that English naval engineers were protesting that they were short handed in the engine room, and that they could not do themselves justice with the force now allowed them. This is the fact in all merchant ships in this country, for the duties of engineers have been greatly increased by the modern high expansion engine. There is not only more work in the engine room than there was ten years ago, but there is a great deal more work all over the ship. Cargo engines, electric light engines, steering engines, everything that has any steam about it and a good many that have none, are expected to be looked after by the engineer's department. Everything comes on the engineer, and it is perfectly plain that they cannot do any more than they can. When men have more than they can attend to properly some things are left undone, and it does not need an argument to prove that machinery neglected depreciates rapidly. More help is needed in the engine room unquestionably, and as it is only a matter of a few hundred dollars a year for salaries, while the loss for the want of such extra help may run into thousands, it appears to be short-sightedness on the part of vessel owners not to increase the force on their ships.

◆

THIRTY-FIVE KNOTS AN HOUR!

THE *Engineering and Mining Journal* has seen the drawings for a new steamer intended to make the Atlantic voyage in $4\frac{1}{2}$ days. She is to be 434 ft. long, 2,880 tons displacement, patterned after the French torpedo boats. The new ship is to be capable of making 35 knots an hour for 24 hours, and an average for the above voyage of 28 knots an hour.

We hope the Secretary of the Navy will inquire into this proposed boat, and if it promises to be practical, ask for authority to build one quickly. It would be a great satisfaction to the public if Congress would show spirit enough to sanction the building of even one vessel that could reach the top notch either in speed or fighting strength. So far, all the additions to the navy have been ships that are lacking in these qualities, as compared with the boats of some other nations.—*Scientific American.*

We respectfully assert that anyone can see drawings. We saw some ourselves two years ago, under which the projector had written "26 knots." Upon asking what these words meant, the designer said they indicated the speed of the vessel (projected). She made 15 miles per hour, under compulsion. When people talk lightly of 28 knots per hour, to say nothing of 35 knots, it is very evident to men of experience that they have much to learn yet. The *Scientific American* can make more money by publishing pictures of snakes than it can by comments like those quoted above.

◆

THE report of a United States consul says:

> I am pleased to report that I was allowed admission to every part of Krupp's works, even into shops and rooms marked "*Entrance forbidden.*" Only by one skilled in mechanics, however, could an intelligent description or statement be made as to what was seen, and in the absence of such a technical education it is impossible to go very much into details.

Just so; that is why you were let in.

◆

THE latest intelligence of the English syndicate in this country is that it has bought Port Royal, S. C.!

FAMOUS AMERICAN ENGINEERS.—NO. 3.

CHIEF ENGINEER B. F. ISHERWOOD, U. S. N.

CHIEF ENGINEER B. F. ISHERWOOD, United States Navy (with the relative rank of Commodore), was born in the city of New York October 6, 1822. He was the son of Doctor Isherwood, a graduate of Columbia College, and a pupil of the celebrated Doctor Mott. He was a great-grandson of Captain Du Clos, a French military engineer of eminence who served through our war of the Revolution on the staff of Lafayette, with whom he came to America. At the close of the war Captain Du Clos married a Miss Stevens, of New Jersey, one of the Hoboken family of the same name, and remained here.

Chief Engineer Isherwood was educated principally in the Albany Academy, of which the distinguished Doctor T. Romeyn Beck was at that time the principal; Doctor Bullion being the Professor of Greek, Latin and Hebrew; and Doctor Joseph Henry, afterwards superintendent of the Smithsonian Institute, being the Professor of Mathematics. The Albany Academy, under these unequaled professors, and managed by the regents of the University, was not surpassed in that day by any educational establishment.

After leaving the Academy, Chief Engineer Isherwood served in the locomotive and car machine shops of the Utica and Schenectady Railroad, under David Mathews, well known for his many and important improvements in locomotives, and here he obtained a thorough practical knowledge of machinery and its construction. He was afterwards draughtsman for Mathews at the same shops, and, on leaving them, he was employed as a civil engineer on the Utica and Schenectady Railroad, then under the superintendency of William C. Young, a graduate of West Point, and himself a well-known civil engineer, the Utica and Schenectady Railroad having been built by him, among his other works. While on this road Chief Isherwood was the assistant of Mr Lake, an eminent English civil engineer, who was the resident engineer at Schenectady, and afterwards extensively employed on the Government canals in Canada.

On the completion of the Utica and Schenectady Railroad, Chief Engineer Isherwood, on the recommendation of Mr. Young and others, became an assistant engineer on the construction of the Croton Aqueduct, under John B. Jervis. When the portion of the aqueduct on which he was employed was finished, Chief Engineer Isherwood went as a civil engineer to the Erie Railroad, being attached to the Susquehanna Division, of which Charles B. Stuart, afterwards Engineer-in-Chief of the Navy, was at that time the chief engineer. After this he was employed by the Treasury Department in the survey and construction of lighthouses under Stephen Pleasonton, at that time the fifth auditor of the Treasury and superintendent-general of lighthouses, by whom he was sent to France to direct the construction of some dioptric apparatus for lighthouses designed by himself.

At this time Chief Engineer Isherwood entered the Engineer Corps of the United States Navy, in which he has remained ever since, having been actively engaged in the various duties of its various grades until he reached the age limitation in 1884, and was placed on the retired list, according to law. During this time he served as Engineer-in-Chief of the Navy during the eight consecutive years covered by the administrations of Presidents Lincoln and Johnson. The Bureau of Steam Engineering in the Navy Department was created for him early in the administration of President Lincoln; he was its first chief, and remained its chief until the end of President Johnson's administration; consequently his term of service embraced the entire war, and gave him a splendid field of operation. During the whole of this period he was, in addition to performing duties of his Bureau, actively engaged in original engineering investigation of all kinds, losing no opportunity for experimenting, as the only infallible source of engineering knowledge, and giving the results to the world in two large quarto volumes well known as "Experimental Researches in Steam Engineering." A very small portion, however, of his experiments, have ever been published. He was not only an indefatigable experimenter himself, but was the cause of others making experiments, and he may be called the inventor or originator of the present kind of steam engineering literature.

His well known experiments on the economic effect of using steam with different measures of expansion, made at Erie with the machinery of the United States steamer '*Michigan*,' by order of the Navy Department in 1860 and 1861, opened quite a new field and gave a new direction to steam engineering, followed as they were by many others elucidating this and other germane problems of the highest importance.

At the commencement of the war, Chief Engineer Isherwood, on becoming the Engineer in Chief of the Navy, found it with but few steamers and few engineer officers, when many of both were instantly needed. He had been employed by the Russian government a few months previously to design and superintend the construction of two gunboats for the Amoor river. The machinery of these vessels was built at the Novelty Iron Works, New York City, which establishment, of course, had the drawings and patterns ready made. The Navy Department, on the recommendation of Chief Engineer Isherwood, immediately contracted with the Novelty Iron Works for four duplicates of this machinery, and thus, in the briefest possible time, were obtained the well known ninety days gunboats, which, together with many succeeding ones, having machinery designed by Chief Engineer Isherwood, afterwards played so important a part in the blockade of the Southern coast and the naval operations directed against it. The machinery of these gunboats was quite novel in design, and the type was afterwards extensively used down to the introduction of compound engines.

During the war, and as rapidly as the engineering resources of the country could be brought into use, both in the navy yards and in all the private establishments that would take contracts, sloops of war—from those of small size to those of the largest dimensions—were produced, besides many paddle wheel steamers for special purposes. The machinery of all these vessels was designed by Chief Engineer Isherwood, and built from the working drawings and specifications furnished by him down to the smallest minutia. Every one was eminently successful, and they were the fastest ocean steamers of their day for their tonnage. Those of the '*Wampanoag*' class were celebrated for their great speed, and in that particular have not been exceeded to this hour by any ocean vessel of their displacement burning their fuel with natural draught. The hulls of these vessels were designed by the Bureau of Construction in the Navy Department, but Chief Engineer Isherwood was always consulted in reference thereto, and his suggestions embodied. He also designed the machinery for the large wooden monitors '*Miantonomah*' and others.

The designing of this immense mass of marine steam machinery was the unassisted labor of Chief Engineer Isherwood, performed during the war in addition to his administrative duties as Chief of the Bureau of Steam Engineering.

There can be shown few cases in which a single officer, entirely alone, and often violently and unreasonably assailed with great bitterness, as was, however, to be expected under the circumstances, sustained so great a responsibility so long with such signal success. Presidents Lincoln and Johnson were entirely satisfied with him, and he retained the absolute confidence of Secretary of the Navy Welles throughout his two terms of office in the Navy Department, both as regards skill as an engineer, and administrative ability as a chief of one of the two most important bureaus in the Navy Department.

After leaving the Bureau of Steam Engineering, Chief Engineer Isherwood was the Chief Engineer of the Mare Island Navy Yard, after which he was sent by the Navy Department to Europe, in conjunction with Chief Engineer Zeller, to examine the vessels, arsenals, shops, etc., of the great naval nations there. He inspected every navy yard in Great Britain, France, Italy and Austria, examined the principal war vessels of those countries, and visited almost every private manufacturing establishment of steam machinery in western Europe. On his return he was appointed President of the Naval Experimental Board, and made a great number of important experiments, his reports, printed by the department, being regarded as classics. In this occupation he reached the age of sixty-two years, and was placed by the law on the retired list of the Navy, with physical and mental powers unimpaired.

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L. HOLLOMAN, of Tampa, Florida, seems to have his wits about him.

A valuable engine was in the round house when it caught fire. When the engineer arrived the building was in flames, but he determined to save his engine. He ran in the burning building, threw a pile of waste in the furnance of the engine, threw kerosene on it and lit it, and then was compelled to retreat to the water tank, as the heat was so intense that it was fairly scorching him. As soon as he thought the engine had steam enough to move it he threw the throttle wide open and ran ahead and fairly came out through the flames with it. In recognition of his service Mr. Ybor presented Mr. Holloman with $50.00.

Foreign and Domestic Trade Literature.

FORCED DRAUGHT PRACTICALLY.

The '*Santon*' is one of the few cargo vessels afloat utilising forced draught. The engine-room is scientifically ventilated, and in the tropics, when the temperature on deck was unendurable, the stokehold was comparatively cool and comfortable. The speed of the '*Santon*' on trial, with 2,000 tons on board, was 11½ knots. On the present voyage the '*Santon*' took in only 1,300 tons of coal, and had to proceed without coaling upwards of 14,000 miles. Throughout the 14,000 miles of straight out steady steaming which the '*Santon*' accomplished, the engines were never stopped once from any cause, and the boiler pressure was never below 154 lbs. This is a feat which has never yet been excelled. The engineer writes, October 9,1889: "The forced draught has been giving every satisfaction. I have been running the fan from 230 to 250 revolutions per minute, giving a pressure in the ashpits varying from 0.2 in. to 0.5 in., according to the condition of the fires, and the pressure above the bars being 0.1 in. After trying various pressures, I found this gave the best results with the coal we were burning. The tubes were never swept during the voyage, and we were steaming as easy the last day as the day we left. I found it of great advantage in the tropics; the temperature of the stokehold seldom reached 100 deg. Fahr., so that the stokers could always work without being oppressed, and the steam pressure never varied one pound. Not a single bar was burnt down during the whole voyage, and the furnace fronts and baffle plates are in perfect condition."

The '*Santon's*' measurements are as follows: Length, 315 ft. over all; beam, 39 ft.; depth, 23 ft. 3 in.; gross tonnage, 2,504. The engines are triple-compound, the cylinders being 22½ in., 36½ in., 60 in., with 39 in. stroke, while the boilers can carry steam at 160 lbs. pressure.

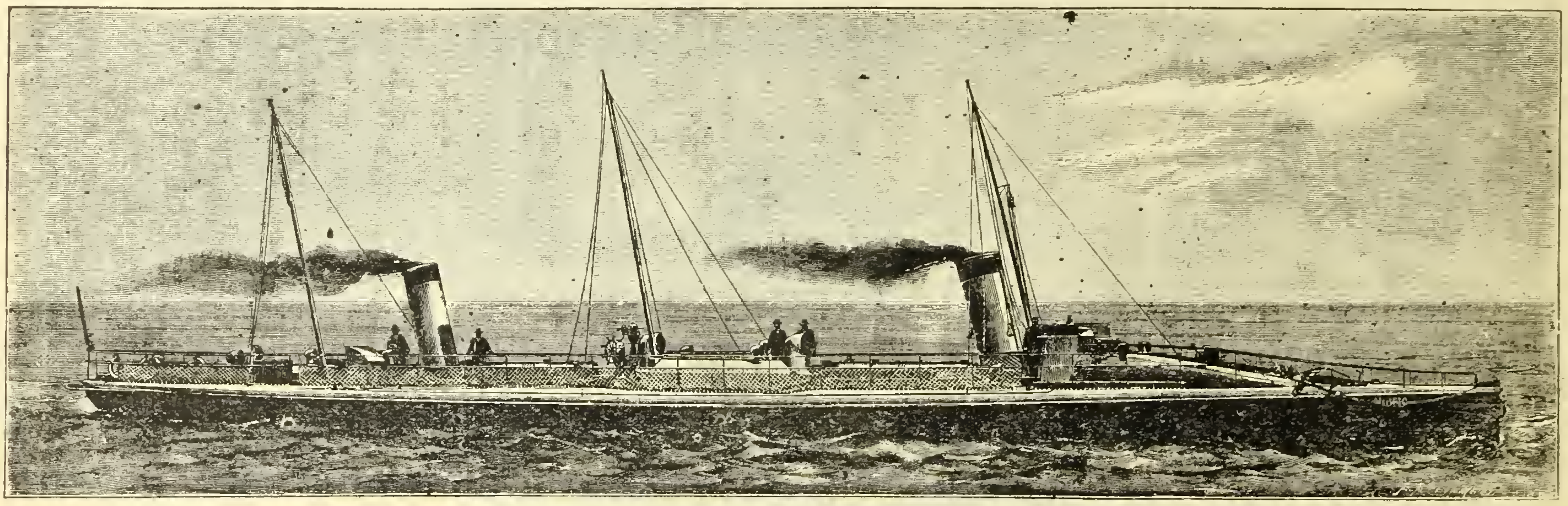
◆

YOU should know how the leading men of the profession look, and what their records are, and this information can be had only in THE ENGINEER. We are making a very complete series of the chief constructors, designers and thinkers in American steam engineering, and shall publish them continuously through the year.

◆

WE regret to learn of the death of Horatio Allen, on the 30th ult.

A VERY FAST TORPEDO BOAT.



THE engraving represents the '*Aquila*,' a new torpedo boat recently built for the Italian Government by F. Schichau, Prussia, and she is up to this time the fastest vessel of her class save one, by the same builders, the '*Nibbio*,' made 26.8 knots per hour as a mean of 3 hours full power trial, while the '*Aquila*' made .2 of a knot less. The boats are 151′ 8″ long, 17′ beam, and draught of water 7′ 6″. The hull is divided into twelve water-tight compartments, there being also longitudinal bulkheads. The vessel will continue afloat if all compartments forward of the boiler are filled with water.

Each vessel is fitted with two locomotive type marine boilers with 1,700 square feet of heating surface, and two sets of triple-compound engines. The latter are placed amidships, while the boilers are placed fore and aft, the propeller shafts passing at the side of the after boiler. The cylinders are 17 in., 26 in., and 37 in. diameter by 17 in. stroke. The total horse-power developed by the engines is about 2,200 indicated; the boiler pressure is 13 atmospheres, and the air pressure in stokehold 1.18 in. to 1.58 in. The propellers are three-bladed and 5 ft. 11 in. diameter. The boiler and engines are entirely enclosed by the coal bunkers. The coal bunkers have a capacity of 40 tons, with which these vessels can steam 5,000 miles at 10 knots speed. The displacement of the boats, fully equipped and with full bunkers, is 160 tons. The displacement during trial was 145 tons. The details of the trial displacement were as follows:

	Tons.
Weight of boilers and engines, with water, etc.	61
Coals	14
Torpedoes, munitions, 24 men, with equipment, spare gear, etc.	7.5
Weight of vessel, with torpedo guns and fittings, Hotchkiss guns, electric engines, signal apparatus, masts, sails, etc.	62.5
Total	145

The trials of these boats were made in the Baltic, the course being defined by fixed landmarks 19 miles apart. Each boat ran at full power for three hours, and the following results are given:

'*Aquila*,' tried July 28, 1888 Strength of wind, 4, with strong running sea; mean speed, 26.2 knots.

'*Sparviero*,' tried August 6, 1888. Wind, 3; mean speed, 26.6 knots.

'*Nibbio*,' tried August 22, 1888. Wind, 2; mean speed, 26.8 knots.

The horse-power is stated to have been about 2,000 indicated, and the engines worked at an average of 320 to 325 revolutions per minute. The boiler pressure was 13 atmospheres, and the vacuum 13.37 lbs. Figs. 6, 7 and 8 show the wave line of the '*Aquila*' and sister vessels when running at 14, 18 and 26.5 knots speed respectively.—*Engineering.*

Fig 6 Wave line at 14 Knots

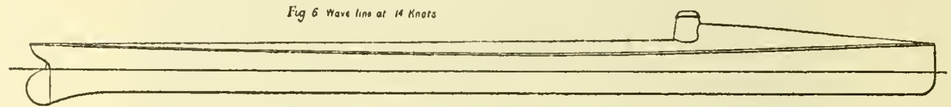


Fig.7. Wave line at 18 Knots

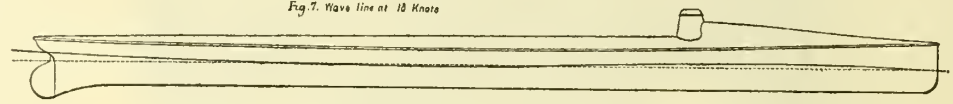


Fig 8 Wave line at 26.5 Knots

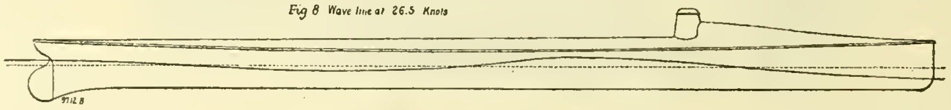


Fig 2

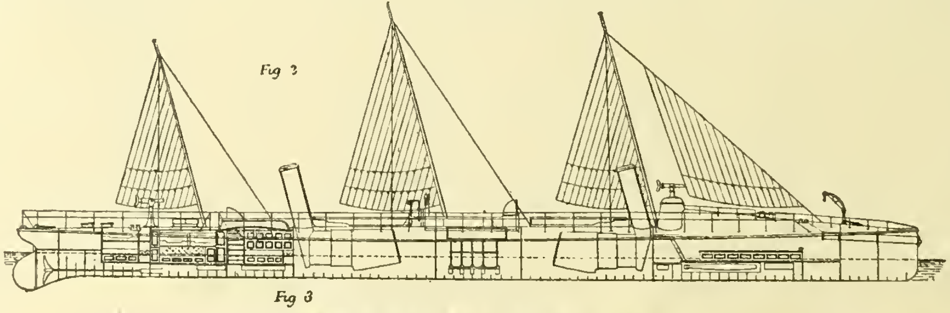


Fig 3

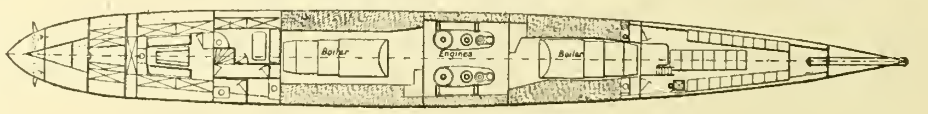
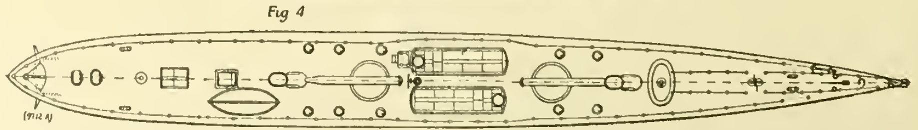


Fig 4



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DR. LARDNER is unjustly accused of having stated in 1835, at a lecture to the Liverpool Albion Society, that steam navigation across the Atlantic was an impossibility, when in reality he only assured the Liverpool merchants that it could not be made commercially successful; and for five-and-twenty years, till the introduction of the compound engine, the steamer could not, without subsidy, compete with the American sailing clippers. It was the compound engine, more than the '*Alabama*,' which destroyed American shipping; and coming to more recent times, we have seen the China and Australian clippers displaced by steamers, rendered commercially possible by reason of their great size and economy in fuel, and by the construction of the Suez Canal.

At the time Dr. Lardner is credited with declaring ocean navigation by steam an impossibility, he was engaged in recommending the overland route to India by subsidized steamers; and the simple calculations with which he urged his arguments are applicable at the present time, allowing for the extra economy of modern engines.—*Greenhill.*

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FRIENDS who may have clubs in hand will confer a favor by forwarding the names at their earliest convenience.

DESIGN AND CONSTRUCTION OF CHIMNEY SHAFTS.

In building a chimney, either from an internal or external scaffold, and when two or more masons or bricklayers are employed, it is usual for them to change their positions, so as to equalize any unevenness in their respective laying of bricks. The work, as it proceeds, should be carefully leveled, and plumbed every 3 ft. or oftener, in order that the batter may be preserved perfectly regular. Special pains should be taken to see that the bricklayers keep the quoins forming the angular corners of octagonal and square shafts in a perfect straight line, as nothing spoils the appearance more than to see the quoins with twists in them, as is often the case.

Strapping.—Chimneys connected with puddling forges, and other furnaces where the temperature is exceedingly high, and where steam hammers are constantly at work causing vibrations, should be strengthened on the outside, to prevent cracking, by 3 in. × ½ in. wrought-iron bands spaced about 3 ft. to 4 ft. apart. These bands can be made an architectural feature if designed with the shaft; the iron joints being made to turn into the brickwork, so that the continuity of the band surface may not be broken. In Woolwich Arsenal nearly all the chimneys are cracked, and have been strapped. It is said that this cracking has been caused to a great extent by the vibrations set up by the large steam hammer when forging.

Access to Summit.—All chimneys should have means provided for getting to the top for examination and repairs. This can be done by building wrought-iron ladders, or ladder irons, up the flue about 1 ft. apart. In some cases, where architectural effect has been of little importance, ladder irons have been built up the outside of the shaft. In America, wrought-iron ladders are sometimes built on the outside, and connected with an iron balcony—supported on cantilevers—which is so arranged that the cap and lightning conductor can be easily examined: the side of the ladder acts partly as a lightning conductor. This certainly is an advantage, but does not add to the architectural beauty. Such an arrangement was carried out at the Merrimac Manufacturing Company's Works, Lowell, Mass., U. S. A. In the early days of chimney construction the common plan which was adopted for gaining access to the top for examination and repairs was rather a tedious one. A kite was flown over the top of the chimney, and was then pulled down to the ground by a second string attached to the string controling the flight of the kite; it was then detached, which left the string hooked over the top of the shaft. A stout cord was then fixed to the string, which was drawn over the shaft until the string was replaced by the cord. This operation was repeated until a rope or chain took the place of the cord, when a "Steeple Jack" would be hauled to the top, from whence he could make proper attachments for fixing a staging; a work most difficult and dangerous at such giddy heights. When the chimney was in work this arrangement could not always be carried out on account of the hot vapors issuing from the flue destroying the cords. On that account most high chimneys were provided with a curved hook or stout iron cantilever fixed in the cap, in such a position as to catch the kite string. There are great disadvantages in this progress of kite flying on account of the delay which continually occurs, from the varying condition of the wind. Weeks, and, it is said, even months have been spent by the kite-flyer at the base of the chimney before there was a favorable breeze. For this and other reasons it has been nearly superseded by an ingenious method of laddering. By this means the top of a chimney 300 ft. high can be reached in a few hours at very little cost.

The practice of turning exhaust steam into a chimney is one of common occurrence, but is one which should be strongly condemned. In the first place it injures the draught; for there is an increase of friction due to the wet, slimy condition of the walls; and again, this hot, damp condition of the walls is injurious to the masonry, the joints being always soft and the brickwork tending to disintegrate.

Brick and stone chimneys, built on correct principles, and substantially constructed with proper materials, should last many years, provided the structure is occasionally examined and the weather kept out of the joints of the masonry by pointing when required.—*Industries.*

13 Atm Boiler pressure. 0,91 Vacuum. = 13 37lbs. *Fig. 5.*

325 Revol^s per minute. 17" Stroke.

Dia. Cyl^r 17" = 26" = 37"

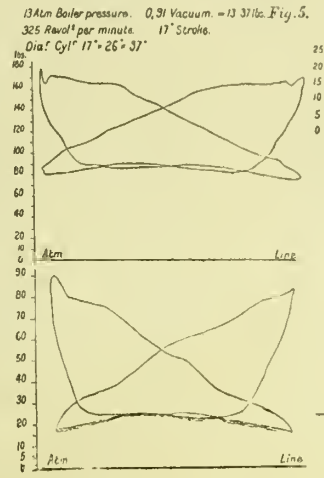
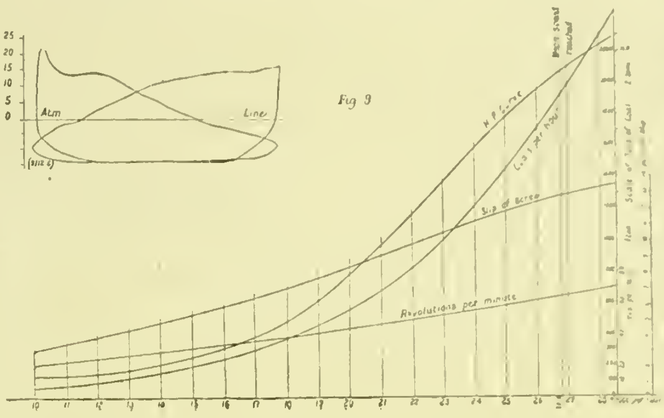


Fig 9



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ELECTRICITY IN THEATRES.

A reporter of a daily paper thus describes the part electricity plays in theatres:

"I found a flight of stairs which led up to the mystic den, where I discovered an expert stage botanist fixing miniature incandescent lamps in all sorts of gaudy-colored paper, roses, tulips and daffodils lying on the table before him.

"I made known my errand, and from the high shelves this creator of stage wonders brought down the sun, moon and various other heavenly bodies.

"He said that last year the sun didn't work very well. It was electrical, but it was without marked difference in its appearance as a new, an old, or a mid-day sun. This year the sun, which is a great tin disk, painted white, is set in a wooden frame, and within this an arc lamp will burn. Colored gelatine sheets are arranged to tint the color of the light to correspond to the rays of the ruddy morning, changing as it rises to the natural hue of the orb it represents, red, or golden, or white, as the scene demands.

"The moon receives its light from the Edison company, and comprises a half dozen incandescent lamps of sixteen-candle power. three of which are of red glass, and three plain. In the moonrise scene of Lohengrin the red lamps furnish at first the only illumination, but, as the moon advances, these are gradually reduced, while the white lights are as gradually turned up, until the pale silver moon of poetry stands fully confessed.

"The stars are star-shaped tin disks painted white, with a single incandescent lamp in the center shining through a minute opening.

"The lamp of gold in 'Rhinegold,' which is guarded by the Rhine god, will be made up of tinsel and glass and illuminated by a current. The bed of the Rhine will also be illuminated by a similar arrangement of light and glittering tinsel, and illuminate up the hidden treasures at the bottom of the water.

"The dragon in 'Siegfried' will have incandescent eyes and glare properly, and the spear wielded by the keeper of the treasure, when in conflict with young Siegfried, being struck by the sword of the lad's father, yields sparks by the aid of a tiny arc lamp fitted about half way between haft and blade.

"In 'Faust,' during the duel between Valentine and Faust, a secondary battery is connected to a copper plate upon the stage, and thence to the sword of the youth. The sword of Mephistopheles is similarly connected, so that when he interferes and completes the circuit by striking up the swords of the combatants, the sparks fall in a merry, mysterious shower.

"In the garden scene, the flower which is plucked by Faust and shines brilliantly through the medium of an electric light concealed within it, is connected by a loop of wire long enough to allow of its being carried away from the stalk to some distance. At a wave of the hand of Mephistopheles, 'gassy,' who is watching from the prompter's box, slowly turns the current down, and the flower fades, as predicted.

"A swarm of fireflies consists of a large number of tiny lamps fastened to the long, leafy rushes in a swamp. A multiple keyboard over the stage, played upon *a la* typewriter, illuminating these irregularly gives a very lifelike representation of the fireflies' wedding dance.

"Dynamo men, and electric lightmen generally, are gradually coming to appreciate the necessity of economy in current. If it is wrong to waste the crude material—the coal—how much worse is it to throw away the manufactured article?

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"I have seen a plant which, for want of a very little knowledge on the part of its owners, had depreciated from a 60 light plant to one of hardly half that capacity, and which required a couple of good workmen over a week to put in good working trim again. The dynamo was in poor condition, the commutator sections were badly roughed up, the lamps worked imperfectly, while the lights danced like fire-flies. Carbon dust had accumulated in the bottoms of the lamps, and this interfered with the feeding apparatus. There were numberless joints in the line, the resistance of any one of which was far more than that of any lamp, so that, while the poor machine did its very best in sending out current, the waste in forcing its way over the line was over one-half the output of the machine, and the furnace was a bottomless abyss of expense.

"The electric generator is an expensive and in some respects rather delicate machine. It requires but a little neglect or carelessness to ruin a dynamo or a motor. There is a certain amount of wear to it, and there is a dire necessity for keeping it perfectly clean and free from copper dust and dripping oil from overhead shafts and pulleys. If it is imperative that the dynamo should be placed in a position exposed to dropping oil, no time should be lost in protecting it. Oil, pure and simple, is not a good conductor of electricity, but dirt is. Oil gathers dirt, and holds it, and dirty oil becomes a dangerous element under such conditions; besides, a filthy dynamo, or any other machine, is always an assurance of one of three characteristics on the part of the party in charge: carelessness, ignorance, or downright, stubborn incompetency.—*Electrical Industries.*

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The proprietor of a patent medicine is liable in damages for an injury done to a person who takes the medicine according to the directions. This, at least, is the law of Georgia, as interpreted by its Supreme Court. What is needed is a law that shall punish men who sell medicines warranted to cure all, or nearly all the ills that flesh is heir to, for obtaining money under false pretenses on proof that the pretended medicine is a fraud and a device to extract money from the ignorant, the credulous and the simple. —*Philadelphia Press.*

CORROSION AND SCALING OF MARINE BOILERS.

It is important, before beginning to study the phenomena attending pitting and boiler corrosion generally, that the dangers of a certain obscure action, involving in many cases totally unlooked for and unexplainable results, should be pointed out, or at least an indication given of the direction in which the danger exists, so that we may, if possible, avoid it.

The nature of this danger is formulated when we say that little or no definite knowledge is possessed as to the action of fatty acids when entering into combination with soluble salts of magnesia and lime under the influence of heat. Sea water is composed of water and soluble and insoluble chemical substances, in the following proportions per gallon:—Common salt, 4.0 ozs.; potassium chloride, .11 oz.; magnesium chloride, .50 oz.; epsom salts, .33 oz.; plaster of paris or gypsum, .20 oz.; chalk, .02 oz.=total, 5 16 ozs.

Out of these 5.16 ounces of matter 4.94 ounces are perfectly soluble in water, leaving only .22 ounces of really insoluble matter. This amount is not sufficient to account for the great quantity of scale often found in boilers, and we are driven to the conclusion that the acids in the boiler water must be capable of exerting some action on the mineral matters in solution and suspension, causing them to be more easily deposited on the heating surfaces. But where do acids in the boiler water come from? From the decomposition of the animal or vegetable matters from which the oil has been made. All oil is formed from either a vegetable, animal, or mineral source, and the oils of the first two substances are turned into glycerine acids at a temperature of about 275° Fahr. These acids concern us as boiler users on account of their great affinity for iron, entering into combination with that metal and forming graphite, accounting for, in a great measure, that softening of valves and cylinder faces and walls so frequently met with.

All oils of a mineral nature are resolved by heat into two gases, viz., hydrogen and carbon, neither of which cause any bad effect on metal placed under the same conditions as a boiler. The degree of heat at which this separation takes place is far removed above the temperature at which even the strongest steam is used.

Having very hastily sketched the composition of oils and sea water, it only remains to repeat what was stated at the commencement, viz., that the unknown action resulting from the chemical combination of acids and mineral salts under heat, must in a greater or lesser degree have some intimate connection with the heavy scale deposit we so often find.

Corrosion occurs in marine boilers principally along the line of fire-bars and the water level of the boiler, and in a desultory manner on the heating surfaces generally. The method of wasting away at the water level is different to that going on on the furnace sides. A heavy formation of rust has most to answer for at this part. The water is brought into contact with the iron, and by reason of the boiling of the water and the movement of the ship, is again taken away, thus allowing the newly formed particle of rust to dry or at least to partly dry.

This skin on drying contracts on itself and cracks, thus throwing open the iron to fresh attacks of the oxygen and hastening the ultimate destruction of the plate at the water level. This destruction is materially assisted by the layer of air that in the majority of cases exists between the water and the steam. Several minor actions are also occurring at this part, all tending by either chemical or mechanical means to abrade the plate. Pitting is caused by the combined action of heat in the plates and acid in the water. Acids are more capable of acting on metals when the metallic substances are at a high temperature than when the same material is cold, in consequence of the difference in molecular arrangement when heated, so that if we take a plate and apply heat at one end of a side, and at the same time expose the whole of the other side to the action of an acid, we will find that chemical action has taken place at the heated end to a much greater extent than at the cold part. If this variation of temperature takes place in a plate forming part of the heating surface, then the small points or indents of good iron are immediately attacked by the acid and dissolved, leaving holes or that form of corrosion commonly termed "pitting." Not only is the good iron destroyed by chemical dissolution, but the very fact of one part of the plate being of a different temperature to another and therefore of different construction, thereby causing part to be destroyed, throws the whole plate into a state of electrical tension, the immediate effect of which is to cause a still more rapid destruction of the heated part which has been rendered what is termed "electro positive," whilst the colder portion is "electro negative," it being borne in mind that in all voltaic electricity the positive element is always destroyed, whilst the negative one is preserved. Seeing that parts only of the heating surfaces are in a state of negative electricity, we adopt a method whereby we make the entire surfaces or plates electro negative, viz., by placing in metallic contract with the boiler zinc slabs, which being a more easily oxidized metal than iron, yields to the attack of the acid and becomes wholly electro positive.

The foregoing will explain why the furnace sides are destroyed in such a marked manner, as owing to the slowness of transmission of heat through the sides, the plate at that part acquires a great temperature, and is by this means easily acted on by acids, and is at the same time thrown into a state of electrical tension, whereby its parts are still farther opened to the attacks of the corroding agent. The action is probably more intense here than at any other part of the boiler.—*Engineers' Gazette.*

(*To be continued*).

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FORCED DRAUGHT.*

During the voyage we had some trouble with the fire-bars, owing to the very limited area for admitting air between them, and the small air pressure available to make up for this deficiency. The bars were $\frac{7}{16}$ in. thick, with $\frac{1}{16}$ in. air spaces between them, and this, after a few days' steaming, was found insufficient to allow the air to pass freely to the fuel on the bars, especially for fuel containing such a large proportion of volatile matter as the Vauxhall, and after carrying out the orders I received, to space them $\frac{1}{8}$ in. farther apart, they bent sideways, owing to the lack of lateral support against each other at the middle of their length.

There is little doubt that thin bars are the best for high rates of combustion, as they will remain uninjured where thicker bars would surely burn. This is because the receptive area bears such a small proportion to the dissipating area in thin compared with thicker bars. By "receptive area" I mean the area of the top of the bars on which the glowing fuel rests, and through which the heat is principally conducted to the rest of the bar, and dissipated by radiation and conduction from the sides of the bars to the air passing between them. This dissipating surface is practically the same in bars of equal depth, while the receptive area varies in direct ratio as the thickness of the bar. The principal objection I have heard urged against thin bars is the impossibility of using a pricker without breaking them, but with a closed ashpit a pricker does more harm than good, and I have burnt 50 lbs. per square foot per hour without using it. The success which has been obtained with similar bars to those mentioned, but with wider air spaces, under exactly similar conditions, shows that this was the right sort of fire-bar to use if more air space had been allowed—a space of $\frac{5}{16}$ in., say. For the preservation of the bars with a closed ashpit, it is important to pay attention to the manipulation of the valves for admitting the air above and below the fuel; and while the air pressure is on, it is necessary to see that one of the bottom valves is always more or less open at the same time as the top one; otherwise the air blowing on top of the fires, with no draught underneath, will cause injury to the fire-bars by overheating them. Care should be taken to rake out the ashpit immediately after cleaning a fire, so as to keep the ashes well away from the bars. The fire-bars should be fitted tight sideways, and after putting in a set of bars—say $\frac{3}{4}$ in. thick at ends—it will be frequently found that, after getting in as many bars as possible, a space will be left perhaps $\frac{1}{2}$ in. wide. Instead of adopting the usual plan of distributing this space between all the bars, it will be found better to fill this space with a couple of thin bars, which will prevent the other bars bending. For this purpose it will be found useful to carry a set of wrought-iron bars $\frac{1}{4}$ in. thick. The number required averages about one and a-half for each furnace, or nine for six furnaces: and if a little attention is paid in fitting the bars in this manner, their durability will be largely extended, and water ashpits found to be an unnecessary refinement at rates of combustion certainly up to 50 lbs. per square foot; and probably much higher rates could be continuously maintained if the difficulty of removing the clinkers could be overcome.

In working the fires I have found that a thick fire gives better results in ordinary work than a thin one, probably owing to the necessity for opening the fire-door occurring less frequently, and the fire not burning in holes and admitting an excessive quantity of air; in large furnaces a fire about 10 in. deep with a slight slope from fire-door to bridge—and contrary to the usual practice with natural draught thickest at the bridge end—will give good results. Care should be taken to prevent any opening between the wing bars and the sides of the furnace, as the fires will always burn in holes sooner in the wings than elsewhere. The great obstacle to the lengthened maintenance of high rates of combustion with ordinary coal—say, rates exceeding 35 lbs. per square foot per hour—is the rapid accumulation of clinker; all the movable bars with which I am acquainted offer no solution to this difficulty, as they are quite unsuitable for high rates of combustion, owing to the receptive area I have before mentioned bearing a larger proportion in these than in ordinary bars, causing them to get overheated, and burning or sticking in their work. With decent coal an average rate of 30 lbs. can be maintained with the fires cleaned at intervals of twelve hours, but some of the inferior coal burnt in the merchant service will not run six hours at this rate. In view of this any contrivance which can get rid of clinker as soon as it is formed will be a great step in advance, and enable boilers to be made much smaller than they are at present to continuously develop a given power; and bearing in mind the ease with which I have seen one and a half cubic foot of boiler shell develop an indicated horse-power in some of the Clan Line ships fitted with forced draught, I confidently anticipate the time when this proportional capacity of boiler will be accounted a usual standard, applicable to large marine boilers of the ordinary cylindrical type, and that this great saving in space will not be at the expense of the durability of the boilers or economy of fuel.

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* Concluded from last issue.

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How is this for the last of the year:

> "The substitution of water-tube boilers is now well-nigh certain to afford a temporary relief, for their economy in space and fuel and first cost has been demonstrated. But they cannot stop the losses that begin with radiation and end with slip."—*N. Y. Sun.*

No, and they cannot prevent reporters from counting them up, either.

ENGLISH BOARD OF TRADE CERTIFICATES.

It has long been known that steamship owners, as well as marine engineers, have had very serious grounds for complaint anent the present system of granting certificates of competency to engineers, not only on account of the gross fraud perpetrated upon shipowners by the Board of Trade in certifying as competent, men who have not learned any mechanical trade whatsoever; but on account, also, of the injustice done to the regularly trained and really competent engineer, by supplanting him with an unskilled laborer, who would gladly accept a shilling or two a week more than a fireman's wages as adequate remuneration for undertaking to perform the duties of a marine engineer, thereby tending to degrade our honorable profession in the eyes of the world, and playing into the hands of those who are dishonorable enough to endeavor to carry out the practice of "sweating" upon their marine engineers.

This certainly is a most crying evil, and one which we hope to see rectified at no distant date; but there are other evils also existent under the same wooden-headed regulations, which are equally productive of harm and redolent of injustice. One of these is the permitting of any person the owner or master of a steamer may select, to sign on as second, third or junior engineer, totally regardless of his previous occupation, or of his having had none at all, and subsequently admitting the discharges he receives, and which are so often given indiscriminately, as evidence that such a person is truly a marine engineer!

Supposing such a person to be signed on as second engineer, and that the chief and third both have certificates, and that either of these has been unfortunate enough to cause damage to the ship or her machinery by want of due vigilance while on watch, the offender would be liable to be tried by a Board of Trade court of inquiry for the alleged offense, and if found guilty could be deprived of his certificate, and his prospects for life utterly ruined. But should the non-certified gentleman be pleased to allow a total breakdown of the engines, or a boiler explosion to take place, the Board have no power whatever, under any of the Mercantile Marine Acts, to call him to account, and he may, after wrecking a vessel in this way with perfect impunity, coolly take his leave of her with his V. G. discharges, join another one, and repeat the programme.

Another view, however, to be taken of this matter is that by sending such a man on board a steamer as one of her engineers, the other engineer (or engineers, if there are more than one beside him) has to do his work, because he is utterly unable to do it himself, and the work *must* be done for the safety of the ship, no matter although it means twenty hours' work a day for those who do it, and neither pay nor thanks to them for their extra toil.—*London Engineers' Gazette.*

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SPONTANEOUS COMBUSTION IN COAL.*

The questions pertaining to spontaneous ignition of coal have received extensive treatment from various boards of investigation which have considered the subject. A recent fire due to this cause brings to light a new feature in regard to the subject.

The facts in the case were that about 5,000 tons of semi-bituminous coal, which were kept in two brick houses, ignited spontaneously in the early autumn, about the middle of September, the fire being discovered in the two houses within a couple of days of each other.

From the indications on the top of the pile furnished by the smoke curling in various places, it was apparent that the fire had extended throughout the whole mass; and the deposition of sulphur on the surface of the pile, as it condensed from the volatile matter rising from the interior of the pile, presented the appearance of yellow dew.

Of the injury to the building by the heating of heavy brick walls to dull redness, and the burning of all timber in contact with the coal, we have nothing to do; but the method adopted by the underwriters in the settlement of the loss was certainly outside of the usual course taken in such matters.

This is, we understand, either to settle the loss on the basis of a lump sum which one party tries to increase and the others to diminish, until, in the spirit of exhaustion, rather than compromise, they settle on an average; and the other plan is to pay for the coal and then sell it to small consumers by forcing the consumption by means of ruinously low prices, which do not reward the seller, and also interfere injuriously with the retail business in the vicinity.

The method used in this instance was to take a sample of the coal from a portion which was uninjured, and subject it to chemical analysis, which gave:

Carbon	76.50
Hydrogen	3.98
Mineral matter	12.13
Sulphur combined with iron	.79
Sulphur in organic compounds	.69

The calorific value of a pound of this coal, as computed from the above, equals 13,594 thermal units. Other samples were obtained from the average of the pile when about half of the coal had been removed to a yard, leaving an oblique plane, which cut through approximately the center of the mass.

These samples were collected from regular points over the slope and taken to a clean pavement, where they were crushed and thoroughly mixed over to obtain a smaller sample for the purpose of analysis, which should represent the average composition of the coal throughout the whole slope. This analysis gave:

Carbon	74.13
Hydrogen	3.95
Mineral matter	13.18

The calorific value of this sample of coal amounted to 13,230 thermal units, 2.68 per cent., as the depreciation of the value of the coal by heating, and it was upon this basis that the loss upon the coal itself was reached. A sample of partially cooked coal, which represented an average sample of the coal actually injured by heat so as to make a noticeable change in its appearance, showed upon analysis:

Carbon	65.77
Hydrogen	1.36
Mineral matter	26.13
Sulphur, total	.82

The calorific value of the coal amounted to 10,409 thermal units, or 22 7 per cent. less than that of the uninjured coal. The cause of the heating was undoubtedly due to the presence of sulphur in its combination with iron, forming iron pyrites.

A defect in the consideration of the liability of various forms of bituminous coal to spontaneous ignition has been due to considering the total amount of sulphur as the measure of hazard, an assumption which contains two errors sufficient in themselves to render that process of forming an opinion entirely unreliable, because the sulphur liable to produce heat by chemical changes under normal conditions, is the sulphur in combination with the iron, forming iron pyrites. This disintegrates under the most ordinary conditions, while the sulphur in organic compounds is not liable to such changes.

Secondly, a measure of this liability is not shown by an ordinary chemical analysis, which represents a sample selected by averaging up a large number of specimens, but the danger is due to the greatest concentration of iron pyrites, and not to its average presence in the whole mass.—*C. J. Woodbury.*

◆

Marine Engineers' Association No. 59, of Boston, sends us an invitation to attend their ball which takes place on the 13th inst., at Lyceum Hall, East Boston. We trust the anticipations of all will be realized.

◆

Did you have it? We had it,

With regard to the durability of boilers working with forced draught, I must say that I have seen nothing to lead me to infer that high rates of combustion are harmful to the boiler, when provision is made, as in Howden's system, for avoiding sudden and violent changes of temperature on opening the fire-door. In fact, my own experience points the other way, and rivetted seams in the combustion chamber which could never be kept tight with natural draught, gave no trouble after the forced draught apparatus was fitted. The explanation which occurred to me was that with natural draught a strong current of air passed through the furnace when cleaning a fire, and impinged on the seams in question, which were in line with the center of the low furnaces. With forced draught this current was much less, owing to the obstructions offered by the air-heating chamber in the uptake and the spiral retarders in the tubes, and this reduced current of air did not chill the seams so much as the stronger current. * * * I take it that the real point at issue is not that more heat or power can be got from 1 lb. of coal by forced than by natural draught, under any circumstances, such, for instance, as the very slow rates of combustion which formerly obtained in some of the old Cornish boilers, but that with forced draught a given quantity of fuel can be made to impart a greater percentage of its heat to the boiler, and this in less time than can be imparted by it when burned with natural draught at the usual rates of combustion, such as obtain in marine boilers at present. I will take for an illustration, 15 lbs. per square foot with natural draught, and twice that quantity with forced draught, which, fortunately for my purpose, happens to be about the mean rate of combustion obtaining in the boilers of the Inman and International Company's Ss. '*Ohio*'. The lower rate mentioned first is that usually obtained with South Wales coal in ordinary sea work at full power with natural draught, and can only be maintained for lengthened periods under these circumstances, with boilers having tubes less than thirty diameters long, and the products of combustion entering the base of the funnel at 700 deg. after a few days' steaming.

◆

When oxide of iron is in contact with wood excluded from the atmosphere, and aided by a slightly increased temperature, the oxide parts with its oxygen, and is converted into very finely-divided particles of metallic iron having such an affinity for oxygen that, when afterward exposed to the action of the atmosphere from any cause, oxygen is absorbed so rapidly that these particles become red hot, and if in sufficient quantity, will produce a temperature far beyond the ignitable point of dry timber. Whenever iron pipes are employed for the circulation of any heated medium (whether hot water, hot air, or steam), and wherever the pipes are allowed to become rusty, and are also in close contact with wood, it is only necessary to suppose that under these circumstances the finely-divided particles of metallic iron become exposed to the action of the atmosphere (and this may occur from the mere expansion or contraction of the pipes) in order to account for many of the fires which periodically take place at the commencement of the winter season. It is very difficult to get persons to believe that there is any danger from fire arising from the contact of steam pipes with wood, notwithstanding that there have been well-attested cases of fires originating from this cause.

◆

The trade journal, on account of its special field of service, sometimes furnishes a direct approach to capable purchasers, nearly every one of whom may stand in need of the article advertised, which would be much cheaper and far more effective than any appeal to an indiscriminate mass of readers such as that represented by a daily newspaper.—*British Mercantile Gazette.*

---

* In *Colliery Engineer.*

TRADE NOTES.

Messrs. Keegan & Halpin, 13 Murray Street, N. Y., have published a new artistic calendar, which will be forwarded to all who may apply for it.

⁂

The Secretary of the Treasury has appointed Joseph Hadfield of New York an assistant inspector of boilers at New York, vice John H. Lindsay, resigned.

⁂

The Hewes & Phillip Iron Works, of Newark, builders of Corliss and marine engines and general machinery, are incorporated with $160,000 paid up capital. The incorporators are the five sons of the late John M. Phillips.

⁂

The British boat '*Brisk*' has given the most conclusive proof that a torpedo may be effective. She fired one of hers at a buoy which had been towed out as a target by her steam cutter, and, missing the buoy, hit the cutter and sank her.

⁂

Engineer C. W. Beckwith, attached to the U. S. Revenue Cutter '*Samuel Dexter*,' at Newport, R. I., died very unexpectedly in that city. He had been ill only a few days and had not yet performed duty, having been ordered to Newport only recently.

⁂

The difficulty of soldering aluminum has heretofore stood seriously in the way of its application in many directions. But that difficulty bids fair soon to be overcome. The best results so far obtained have been with the use of pure zinc as a solder and Venetian turpentine as a flux.

⁂

The '*Kansas City*', was turned out at John Roach's yard on Aug. 10. She will run between this port and Savannah. She is 350 feet long, 45 feet beam, and 27 feet deep. She has triple-expansion engines, supplied with steam from eight steel boilers. Her constructors say she will make 16½ knots an hour.

⁂

Webster Lane, an old member of the Engineer Corps of the United States Navy, died suddenly Dec. 18, at his home in Chappaqua, Westchester County, in the fifty-sixth year of his age. He was made a Third Assistant Engineer on May 23, 1861, was promoted to Second Assistant Engineer in August, 1863, and resigned in March, 1867.

⁂

The continued trials of the British torpedo boats of the '*Rattlesnake*' class point to failure—too much power for the hulls to stand. They are of 735 tons displacement, and their engines are contracted to indicate 4,500 h.p. The last to be tested, the '*Seagull*,' nearly shook herself to pieces with a development of 3,033 h.p., and had to be sent to the dock for repairs.

⁂

It is known that from first to last 28,000,000 persons visited the Paris Exposition. On the opening day 111,000 persons paid to pass the turnstiles; on the closing day 500,000 fought their way within the enclosures. The attendance was the least on Friday, May 10. It is worthy of note that the popular superstition which regards Friday as an unlucky day seriously affected the receipts of that day until the end.

⁂

The board consisting of Chief Engineers Charles H. Loring, U. S.N., George M. Magee, U.S. N., and George W. Roche, U. S. N., and Passed Assistant Engineer J. J. Barry, appointed to conduct a series of tests of coil boilers and report on their suitability for use in large vessels of the navy, is at Charleston, West Va., testing a boiler submitted by Charles Ward of that place. The only other boiler that has been submitted was built by William S. Cowles, of New York. It will be tested at an early date.

⁂

The announcement now comes from Cleveland that the Globe Iron Works, the most extensive builders of steel ships on the lakes, have joined with the Illinois Steel Company in the organization of a company to construct steel ships in Chicago. The new corporation will be known as the Chicago Shipbuilding Company, and six big steel steamers will be on the stocks in its yards within a few months. The yard will be on the east side of the Calumet River, in South Chicago. There will be three slips running at right angles to the river, giving six building berths. It is not intended to put in boiler and machine shops at once, but this will be done before long, and also a dry dock.

⁂

The New York Steam Heating Company has issued a circular notifying their patrons that on and after Jan. 1, $20 will be the minimum charge per month for supplying steam. Secretary Coon said: "It is a case of life or death with us. We have been struggling for eight years without declaring a dividend, and think it is about time we made a dollar out of our big investment. We calculate that under the new rate our capital should net us 4 or 5 per cent. We have been charging from $7 to $10 per month for a luxury, and it has proved an expensive one for us. Now, we think that patrons should be willing to pay a fair and reasonable return. The increase practically means that our patrons must pay us at the rate of about 70 cents a day."

The Sailors' and Firemen's Union met Dec. 27, at 26 Albany Street, and adopted a circular that is to be sent to ship owners and to the Mercantile Exchange. It asks them to appoint a committee to meet a committee from the sailors and firemen on Jan. 14, for the purpose of deciding upon a uniform rate of wages to be paid to seafaring men. The circular says that the condition of very many seafaring men is very bad. The union intends to submit the following schedule of wages to the Committee of Ship Owners and the Mercantile Exchange: For able-bodied seaman on steamers, $30 per month; for able-bodied seamen on sailing vessels, $35; for machinery greasers, $50; for firemen, $45; for coal passers, $35. These rates of wages it is claimed are already being paid by the Savannah and the Pacific Mail Lines. Should the ship owners refuse to accede to the demands of the union, a big strike of sailors, longshoremen, and firemen is threatened in this city. On Jan. 13 the sailors, longshoremen, and other dock laborers will have a great demonstration in this city, Jersey City, and Hoboken.

⁂

The Joseph Dixon Crucible Co., Jersey City, N. J., closes 1889 with satisfaction. Their business has been larger in every branch than in 1888. Their chief new departure in 1889 has been in the large increase of equipment at the Graphite Mines at Ticonderoga. They have laid lines there for a five years' continuous run—tearing down and rebuilding almost everything much larger than before. The specially large increase in the sales of Graphite Paint, Graphite Grease, Graphite Oils, and other Graphite lubricants, has compelled this. The sales of standard and well known Dixon Stove Polish, Dixon Crucibles, and Dixon "American Graphic" Pencils have also largely increased. Their plant now includes 5 steam engines with a total of 375 h.p.; 9 steam boilers of 600 h.p. together, and the use of 150 h.p. water power. We employ 550 persons, and our payroll averages $4,500 per week. We have direct connections with the telegraph companies and the Long Distance Telephone Co. So far as we can see the prospect for 1890 is bright. John A. Walker, Secretary and General Manager.

⁂

By all odds the handsomest, strongest, and lightest boat hull of the size seen in this port in many years is the one called the '*Evolution*,' launched from the yard of James Lennox, at Twentieth Street, South Brooklyn, a few days ago. As a specimen of the shipbuilders' art she is a marvel, although not exactly novel. Instead of erecting the ordinary rib-like frames of oak when building her sides, her designer has used two layers of plank only, which, bent to form, rise diagonally from the keel so that one layer of planks crosses the other at about a right angle. These planks are of cedar and an inch thick. Outside of these, laid fore and aft as ordinary planks are, is a layer of mahogany. This has been rubbed down, filled, and varnished until the surface reflects every feather of light and every shadow as a mirror would do. Her fender rail in the wake of the planshear is of polished oak. The value of cedar and mahogany as timbers for boatbuilding has long been known to canoe builders, but this is probably the first time so large a ship has been built on this coast of such expensive woods. The planks are bolted through and through. The deck beams are strengthened by knees in places, and there is a long hogging frame of yellow pine laid over the inner skin. Give her sea room and she would ride out a hurricane. That she is light as well as strong will appear from the fact that, although 108 feet over all, 23 feet wide, and 6½ deep, she drew when afloat just 15 in. of water forward and 20 aft. Loaded with her machinery she is expected to draw 3½ feet of water aft, and displace 80 tons.

⁂

The wood used in Japan for lacquer work is a light coniferous one known as *hinoki*, and is prepared to receive the lacquer in various ways. For inferior work it is covered with paper, but in the finer qualities of lacquer work paper is not used. The wood is first carefully smoothed, all joints and imperfections are filled, as with putty, with the raw tough lacquer mixed with rice paste, which soon hardens so that it can scarcely be cut with a knife. The whole is then covered with a mixture of inferior lacquer and coarse yellow powder, and is left a few days in the open air to dry, after which it is placed in a moist-air closet to harden. A hard, gritty surface is thus obtained for the next coat. The next process is to cover the whole with two evenly spread coats of lacquer mixed with a fine ochre powder, so as to get an even, smooth-grained surface for the subsequent work. This is rubbed down with a stone, and the parts which are not to receive any decoration are ready for the finishing applications of the lacquer. The other parts are covered with two coats of black lacquer; the first, applied with a broad brush, dries with a brilliant, reflecting surface; when this is quite hard the second coat is applied, and on this the designs are impressed. In Wakasa ware there is no painting or drawing; the white decoration is applied by dropping eggshell powder skillfully by hand here and there, and other designs are produced by pressing various forms of leaves on the soft surface. To get the surface completely smooth again is the next operation, and then a transparent lacquer, colored yellow, is applied with the object of affording a yellow ground for the gold which is to follow. This is covered by successive coats of the same lacquer until a smooth surface is again obtained, beneath which are the gold and decorations.

⁂

A patent lawyer in Chicago named Dixon has secured a patent upon a detail in the Westinghouse airbrake, in spite of the opposition of the Westinghouse Company. The Commissioner of Patents rendered his decision late last week, and the Westinghouse Company intends to take an appeal. A few years ago the Westinghouse people made a trip through the country experimenting at various places with a new contrivance in connection with their airbrake. They were seeking to improve the storage tank placed under each car, so that the invention might be applied to freight trains. The new device did not work, and they invented another, of which the storage tank was a feature. In the course of their experiments, Mr. George Westinghouse, Jr., says,—Lawyer Dixon saw the first contrivance at Burlington. Knowing that it was not patented, he applied for a patent. Meantime the Westinghouse Company had taken out patents on the new device, and had neglected to ask for patents on the tank. Eventually they filed their application and contested Dixon's claim. The Commissioner decided against them on the ground that they had been dilatory in making their application, although he acknowledged that they were the originators of the idea. Mr. George Westinghouse, Jr., President of the Company, said yesterday: "The decision of the Commissioner does not worry us at all. The essential features of our airbrake were invented about seventeen years ago and have been in use ever since. Dixon's patent is a mere detail sued for in 1887. He cannot possibly injure us, because if he tries to collect royalties or anything of the sort we shall rest upon the priority of our general invention. He never would have had a chance had I not been so busy at the time that I could not attend to this matter. This kind of thing is by no means infrequent in the case of important inventions which are worth millions. All kinds of attacks are made upon them, and this I think, is simply an attempt to raise a scare by which the stock of the corporation would suffer a decline. Speculators could then buy in at a low figure, and afterward sell out a profit. We shall go on as usual. I do not think any court would sustain an action for damages if Dixon should bring one, because his invention, which he didn't invent, is subsidiary and supplementary to the one we use."

CLUB RATES FOR 1890.

In former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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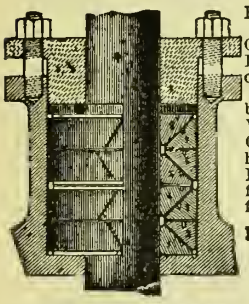

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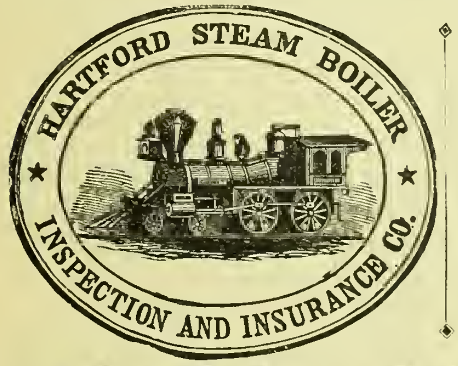

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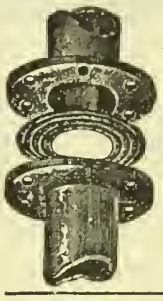

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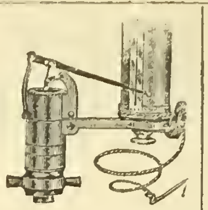

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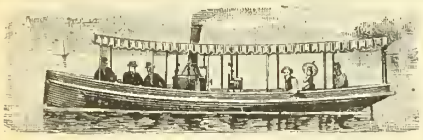

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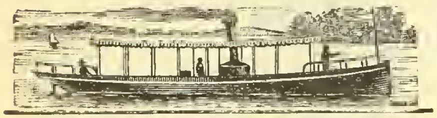

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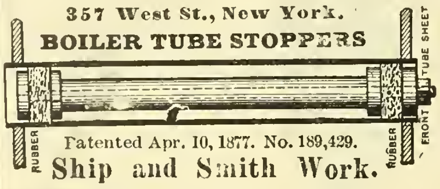

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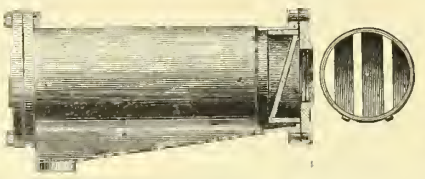

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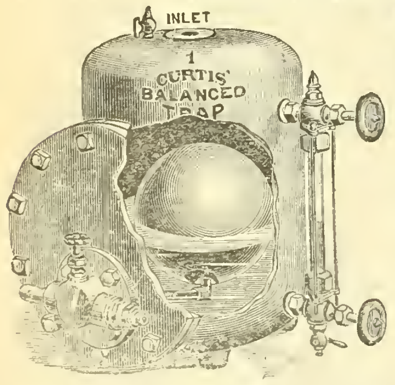

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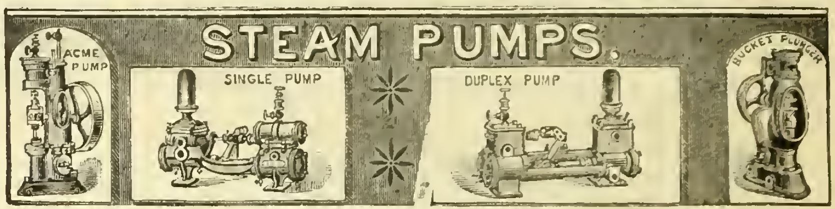

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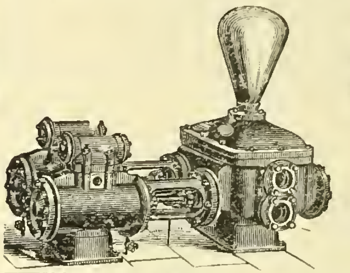

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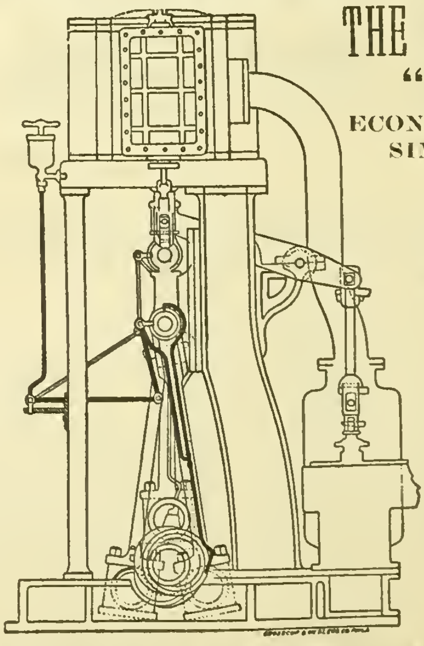

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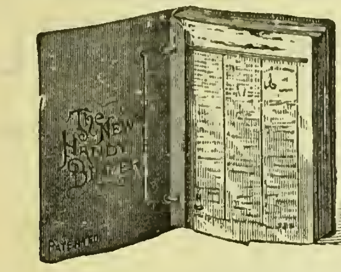

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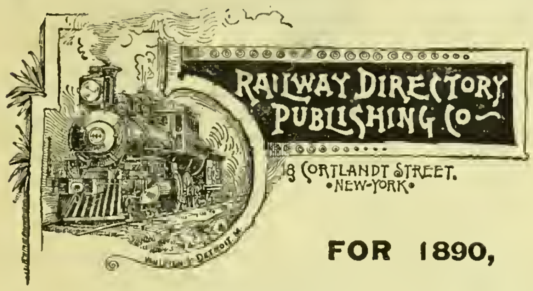
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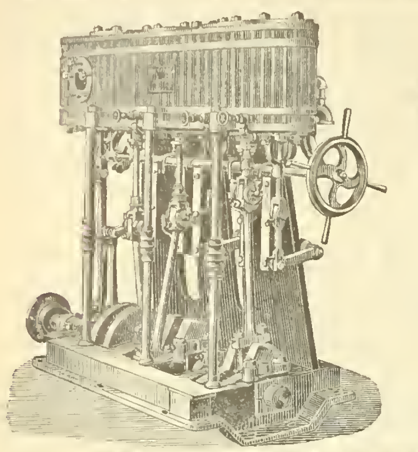

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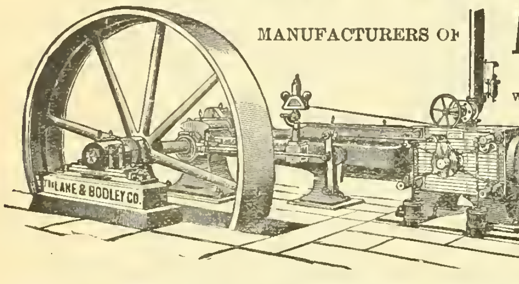
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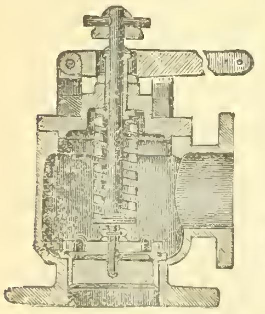

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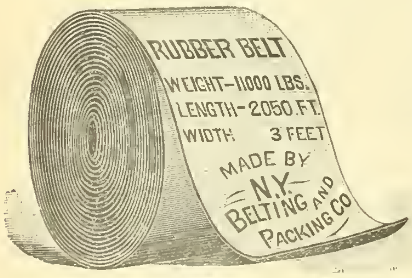

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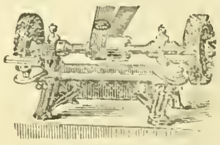

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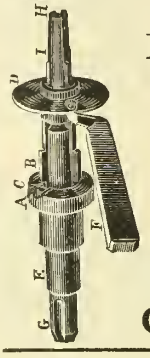

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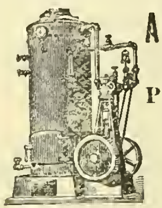

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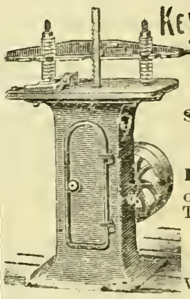

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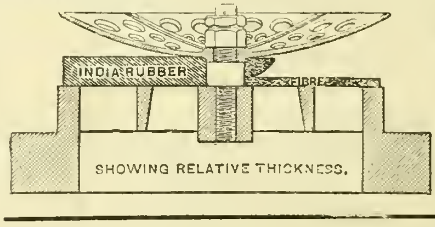

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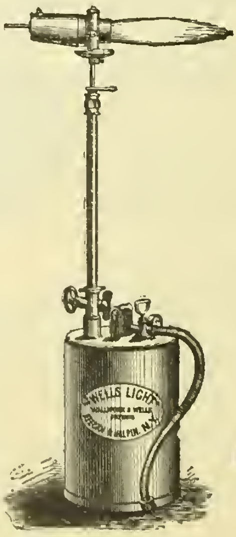

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NEW SERIES, 1883, 1888. VOL. XIX. NO. 2.
NINTH YEAR OF PUBLICATION.
STEAM ENGINEERING, APPLIED

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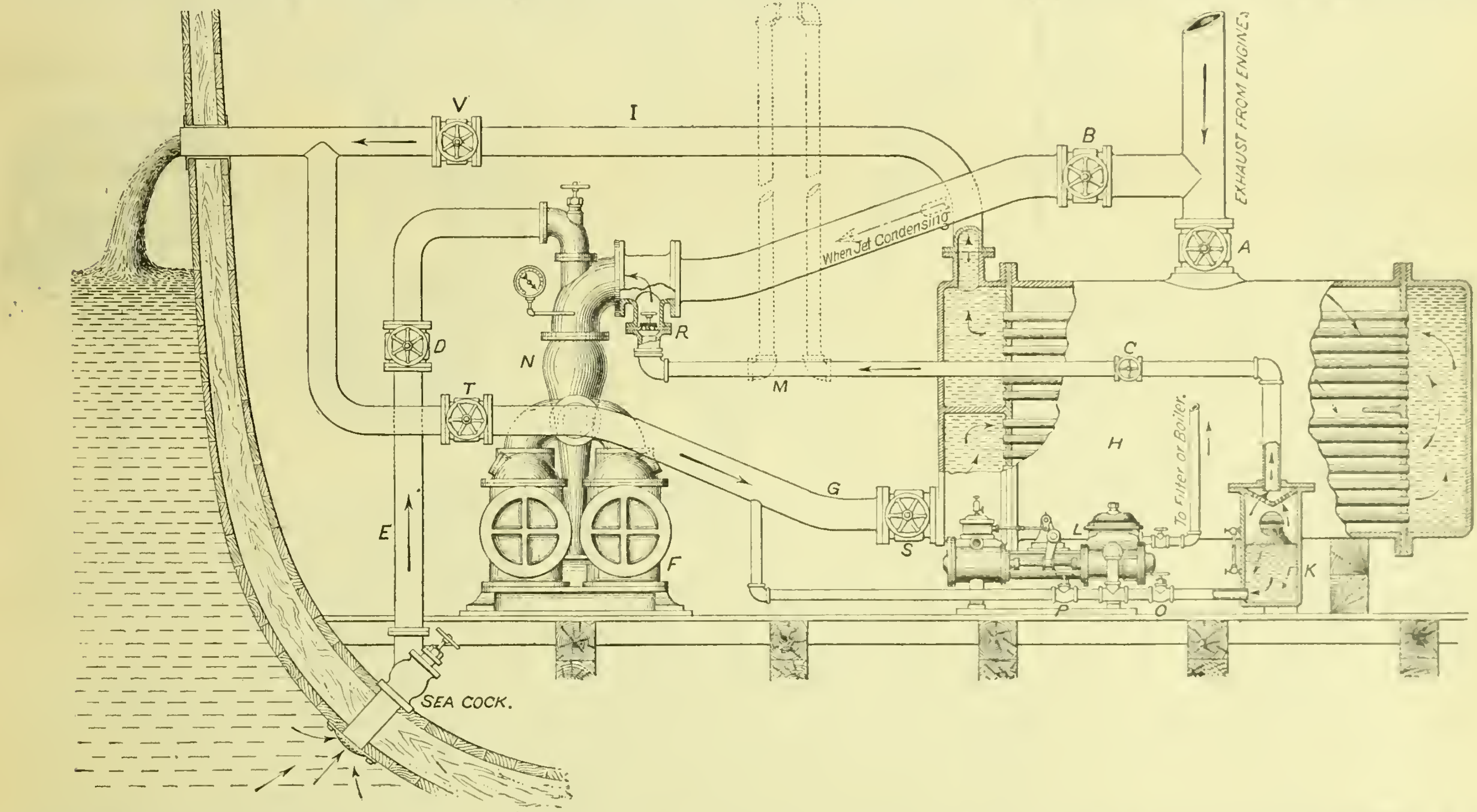
JANUARY 18, 1890.
MECHANICS, AND THE ALLIED ARTS.

THE WORTHINGTON INDEPENDENT CONDENSER.

IN CONNECTION WITH SURFACE CONDENSERS AS AIR AND CIRCULATOR COMBINED.

IN surface condensation two objects are in view: one to obtain the benefit of a vacuum on the main engine, and the other to keep the water of liquefaction of exhaust steam separate from the cooling water, so that it can be used in the boilers. The reuse of this pure (distilled) water in the boilers assures freedom from incrustation, or deposition of salts on the heating surfaces. For this reason, seagoing steamers have adopted this method of condensation almost exclusively. It does away also with the necessity of carrying fresh water in tanks for the boiler supply. In connection with stationary steam engineering, the difficulty sometimes experienced in getting pure water has led to the introduction of the surface condenser on land to some extent. The operation of this condenser is as follows: By means of a pump, cold water of any purity is circulated on one side of a series of thin copper or brass tubes of small diameter set in a closed vessel. The exhaust steam from the main engine is brought in contact with the other side of the tubes. The steam being instantly condensed, falls as water to the bottom of the vessel, from which it (together with the air and uncondensable vapor) is removed by the air pump. This pump delivers into a hot well, and from this hot well the pure water is forced into the boiler in the usual way. Sometimes the surface condenser on small boats is so arranged that the motion of the boat will cause the circulation of the cold sea water. The efficiency of this plan is destroyed when the boat stops, and weeds and mud often entirely prevent the circulation. In connection with surface condensers, the Worthington independent condenser has a field of usefulness that is at once apparent to those who will consider its functions. It performs the duty of two distinct pumps, the air pump and circulating pump. It produces a high vacuum, and causes a positive movement of the cooling water. By its use, derangement of the surface condenser does not deprive the engine of vacuum, as the independent condenser can be used as a jet condenser for the time being. The fact that one pump is dispensed with should commend the arrangement to engineers. The manner of attaching the Worthington independent condenser is shown herewith. The exhaust from the engine is conveyed by the large pipe at the top of the surface condenser through the valve *A* directly around the tubes. Through these tubes sea water from the sea-cock is being circulated by the pump *F* by pipes *E*, *G* and *I*. The quantity of water is regulated by injection valve *D*. The condensed steam water falls to the bottom of vessel *H*, and into the hot well *K*, from which it is taken, and supplied to the boilers. A boiler feed pump is required where air and circulating pumps are employed, as well as with the independent condenser now illustrated. Air and uncondensable vapor that become separated from the steam when it is liquefied, would accumulate were it not for the inducing action that takes place in the cone *N* of the independent condenser. The spraying water entering by pipe *E* maintains the vacuum by entrapping the air which is conveyed from the hot well *K* by pipe *M* to the cone *N*. The air, thoroughly mingled with the water, falls into the pump, and after passing through the tubes of surface condenser *H*, is discharged overboard by pipe *I*. The small vapor pipe *M* is provided with a check valve *R*, as shown, which would prevent the circulating water from entering the pipe, and thus flooding the hot well and surface condenser with impure water, if, through any failure on the part of the pump *F*, the water should rise in the condenser *N*. An equivalent water check for this purpose may be formed by causing the pipe *M*, as indicated by dotted lines, to extend to such a height, say thirty feet, above the surface of the water supply, so that the vacuum formed in the surface condenser will not be sufficient to cause the water to rise, and thus reach the hot well. Such a precaution need not be taken when the engine is arranged to run jet condensing, as in this latter case it is not possible for the water to get back to the exhaust pipe, because the volume of steam that accumulates when the spray pipe becomes submerged and condensation ceases, instantly destroys the vacuum and blows the water out through the pump and discharge pipe. In addition to the saving of one pump in connection with the surface condenser, this combination provides a jet condenser, which can be used whenever it is necessary to suspend the operation of the surface condenser for cleaning or repairs, or any other reason. As the whole apparatus is independent in its action from the main engine, the condenser pump, which controls it all, is easily regulated to exactly suit the requirements. In case of derangement of any part of the surface condenser, by simply closing the valves *A*, *C* and *O*, and opening valves *B* and *P*, the apparatus may be converted into a jet condenser. The exhaust steam, by passing valve *B*, enters the independent condenser, and is condensed by direct contact with the cooling water, and the vacuum is produced in the ordinary way. The boiler feed water, which will be sea water in this case, may be taken from the pipe *G*, the small pipe and valve *P*, the connection with the hot well, via valve *O*, being closed. The surface condenser may be completely separated and rendered accessible for examination by closing valves *S* and *V* also, and opening valve *T*. For steam canal boats and yachts, a very compact, and at the same time easily accessible combination, has been devised. This combination of air and circulating pump can be applied to any of the well-known forms of surface condensers. Address H. R. Worthington, New York.



◆

THE OVERHAULER.

RECENTLY a person applied for a situation as an engineer. He was asked for his credentials He produced quantities of these, showing that he was (by them) an engineer. He was engaged, and the superintendent of the works said to him:

"We are going to lay up for a week and overhaul the shop, you had better overhaul the engine, too, meanwhile."

"All right," said the man, and away he went.

In the afternoon he came back and told the superintendent the engine was all overhauled, and what should he do next?

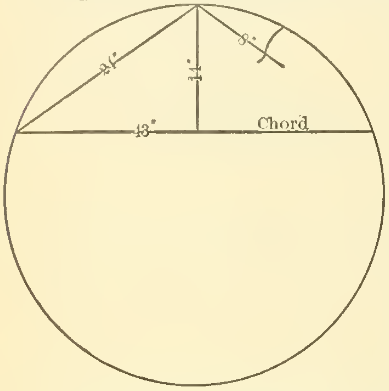
The superintendent looked at the man a minute, and then went to the engine-room. There laid several members of the engine on the floor, and around the room in various attitudes of dejection and despair, or as much so as valves and pistons can express.

"The next thing you can do," said the superintendent, "is to clear right out of this as soon as possible."

BOILER MAKING. No. 31.

By John Cook.

In a former paper I said it would be a good thing if someone would get up a book with rules in simple arithmetic, and explain how they were done, to get the distances for rivets, stay-bolts, and braces for different pressures, in various sizes and styles of boilers. Not wishing to pose as a Solon myself, I will give a few of Haswell's rules simplified, as I understand them. He says that for plates up to .4375″ in thickness, which means $\frac{7}{16}$ths, F is a factor which is 95. All over $\frac{7}{16}$ths, the factor is 105 for stay-bolts, screwed and riveted over. Suppose we want a boiler of the locomotive type, to stand 150 lbs. of steam, working pressure, made of $\frac{3}{8}''$ iron or steel, it don't matter which in this case, for all depends on the bolts. Thickness of plate being $\frac{3}{8}$ths is equal to 3$\frac{6}{16}$ths. The square of this is $\frac{36}{16}$ths, and 36 multiplied by 95 (the constant) gives 2,420, which divided by 150, the pressure carried, leaves 16. The greatest square in 16 is 16, and the root of this is 4, so that the distance between centers of staybolts is 4 inches for a boiler to carry 150 lbs. of steam. Then:



```
       36
        95
      ----
      180
     224
     ----
150)2420(16/4
     150  16
     ----
      920
      900
      ---
       20
```

I think this will be plain enough for a good many of those that can't understand the rules as given in the book.

To find the area of staybolt is not of much use, as most all boiler makers use $\frac{7}{8}$ in. staybolts. That is rather below the right size.

The rule is to multiply the distance between centers, or pitch of bolts, by the square root of the pressure, and divide by 72; the product is the area of bolt wanted. Say the pressure is 150 lbs., and the distance between centers of bolts is 4 inches, then the square root of 150 is 12.24+, and that multiplied by four gives us about $\frac{15}{16}$ths; 1″ staybolts would be right.

```
      12.24 +
          4
     ------
 72 ) 4896 ( 68 = area.
      432
      ---
       576
       576
       ---
```

In getting the distance for braces for stationary or portable boilers it is generally done by the "rule of guess." In some boilers you will find on the same head the braces put some $5\frac{1}{2}''$ apart, and others $9\frac{1}{2}''$ and even 12″ apart. I call that material thrown away. Braces should be set as carefully as staybolts, and in any boiler that carries 80 lbs. of steam the braces on heads should never be more than 7″ apart; the shanks of them not less than 1″ round iron. To illustrate this, suppose we have a boiler 48″ diameter, with forty-six tubes, 3″ diam., with man-hole under the tubes. The tops of the tubes will be 8″ above center of boiler, and they are good (as stays) for 2″ above themselves. From thence we start to get the area of segment (or exposed surface) to calculate how many braces we require. The rule is this:

To the chord of the arc we add the chord of half the arc and one-third of it, and multiply the sum by the versed sine; that sum by .40426, which gives us four hundred and twenty-four and a half square inches of area in the segment. Now, if we allow $47\frac{1}{4}$ square inches to each brace to hold, it will give us nine braces $6\frac{7}{8}''$ apart.

Perhaps it would do no harm to give a few of Lloyd's rules for getting the strength of joints and rivets, and explaining them so that they can be understood by all. One formula is as follows: $\frac{t.J.C.}{D} = P$; t represents thickness of plate; J a per cent of joint, C a constant; D, diameter of shell; P, the pressure in pounds.

```
                               .3125 = thickness of 5/16 plate.
                                   6 = per cent. of joint.
                             -------
                             18750
                                200 = constant for 3/8 pl.
                             -------        and under.
Diameter of shell = 48)3750000(78.125 = pressure; say
                       336                     78 lbs.
                       ---
                        390
                        384
                        ---
                         60
                         48
                         ---
                         120
                          96
                         ---
                          240
                          240
```

To get the thickness of plate for a given pressure the formula is: $\frac{P.D.}{C.J.} = t$; which means to multiply the pressure by the diameter and divided by the sum of the constant multiplied by the per cent.

```
                78.125 = pressure.
                    48 = diameter.
             ---------
   200         625000
     6        312500
  ----       ---------
  1200 )  3750.000 ( .3125 = thickness of plate.
          3600
          ----                      43
           1500                     24
           1200                      8
           ----                     --
            3000                    75
            2400                    14
            ----                    --
             6000                  300
             6000                   75
                                  ----
                                  1050
                                .40426
                                ------
                                  6300
                                 2100
                                4200
                               4200
                              ---------
                              424.47300
```

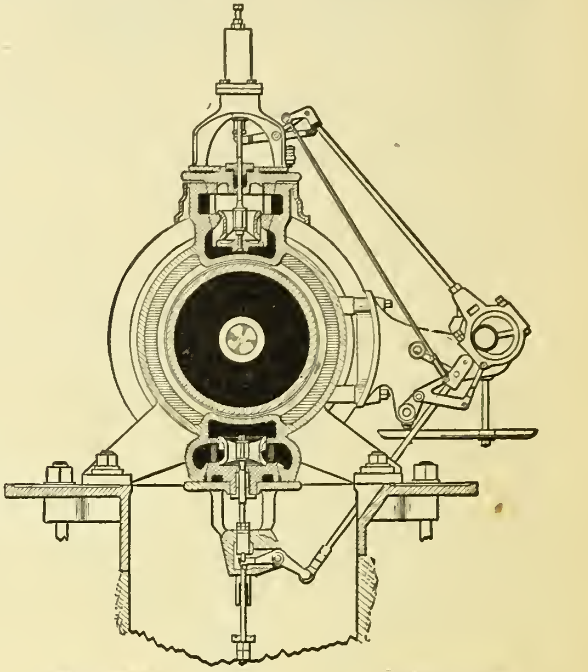
I think if boiler makers would study the rules given in text-books it would be a good thing for them and the public.

(To be continued.)

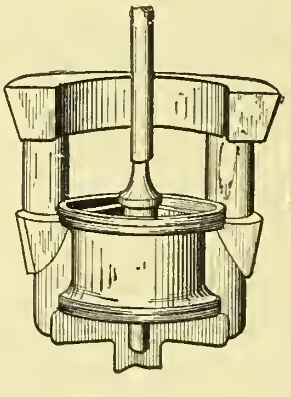
◆

PECULIAR PUPPET VALVES.

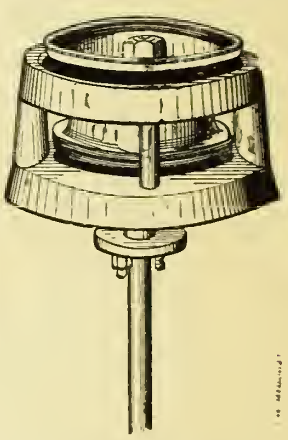
The puppet valve (so-called because it pops up like a puppet in a show) is regarded with special favor in this country, because it has so many good qualities. It is cheap to make, easy to handle and operate (when of the double disk type), and has been so long in use that it seems indigenous—or belonging to the country—but it is not an American invention; it is one of the earliest forms of steam valves. As made by American engineers it is different from the puppet valve used abroad. Our valves of this kind consist of two disks, one over the other, the bottom one being the smallest on the steam side, so as to admit of going through the upper seat, and the bottom disk the largest on the bottom side of the exhaust valve, so as to keep the valve tight on its seat. For sea use these valves are made of brass, with brass seats in iron chests, but this is a disadvantage which has never been remedied. The two metals do not expand equally, and the valves are not tight. For fresh water use on the Great Lakes the valves and seats are of cast-iron, and no trouble is found in making them tight. Another disadvantage with the usual form of puppet valve is the great spaces occupied by it, which require to be filled with live steam. This increases the clearance, a matter which it is desirable to avoid. The valve here shown is that used by a Swiss firm of engineers, the Messrs. Sulzer of Winterthur, and seems to be a modification of the usual form of puppet valve in many respects. It might be said to be a cross between the piston valve and the puppet valve, as it combines the features of both types. There are no disks, but the valve admits steam from the inside, and the clearance spaces are reduced to their lowest terms. The balance is as close as it can be, merely the difference between the areas of upper and lower seats, and it requires the aid of a spring to keep them down and make them close quickly; it is the fault of ordinary puppet valves that they do not close quickly unaided. There is a certain interval of time between releasing them and reaching the seat, during which time the piston has traveled some distance farther than the point of actual release of the valve.



Admission Valve



Exhaust Valve



It will be seen by the engraving that these valves are let into the end of the cylinder so that the piston clearance is very small. It is asserted that sets of these valves have been run fourteen years without being re-ground, and were in perfect condition. The engravings are taken from the *London Engineer*.

◆

President Johnson, of the Edison Company, has retired from the management. He says: "Just why I retire is my own affair. I will say, however, that I shall soon be ready to submit to the public something of greater importance and general interest than anything brought out for years in electrical development. I have found a complete solution of the problem of safety in electric light wires. That is the thing that I now intend to bring out. When I submit it for public inspection I shall be ready to prove that all danger from electric wires can be removed. I think that is well worth a good share of my attention, which I could not give to it if I were bound to duties that others are fitted to perform capably."

◆

An unknown cynic says the young man on the lookout for a "soft place," through a dislike for honest hard work, can find one under his hat.

ELECTRICAL TERMS IN COMMON USE.

Now that so much discussion is going on in the papers concerning the proposed method of execution by electricity, we are constantly meeting with the words "ohm," "ampere," "volt," and others, the meaning of which are not familiar to us. The following definitions will straighten them out to a certain extent:

Current. A current, in the electrical sense, means a flow of electric force through a wire or some other conducting substance. A continuous current is one which flows all the time in one direction. An alternating current is one which flows first in one direction and then in another, the reversals in direction taking place very rapidly. A Westinghouse dynamo gives about 150 reversals a second.

Ampere. Some currents of electricity are more powerful than others, and it is customary, in speaking of their intensities, to compare them with a standard current called an ampere. An ampere is of such a strength that it will decompose 5¼ grains of water per hour. The name comes from Ampère, a celebrated French electrician.

Dynamo. This word is derived from a Greek word meaning "power." A dynamo is a machine for converting mechanical energy into electricity.

Resistance. By this word is meant the opposition that a wire or other conductor offers to the passage of a current of electricity. Thus it will be readily understood that it is not so easy to send a given current of electricity through a long wire as through a short one; nor through a little one as through a big one.

Ohm. This is the unit of electrical resistance. Resistances are compared with one another by stating how many ohms they are respectively equal to. A wire of pure copper that is 0.056 inch in diameter and 100 yards long offers a resistance of one ohm to the passage of an electrical current. The word "ohm" comes from the name of a German electrician—G. S. Ohm.

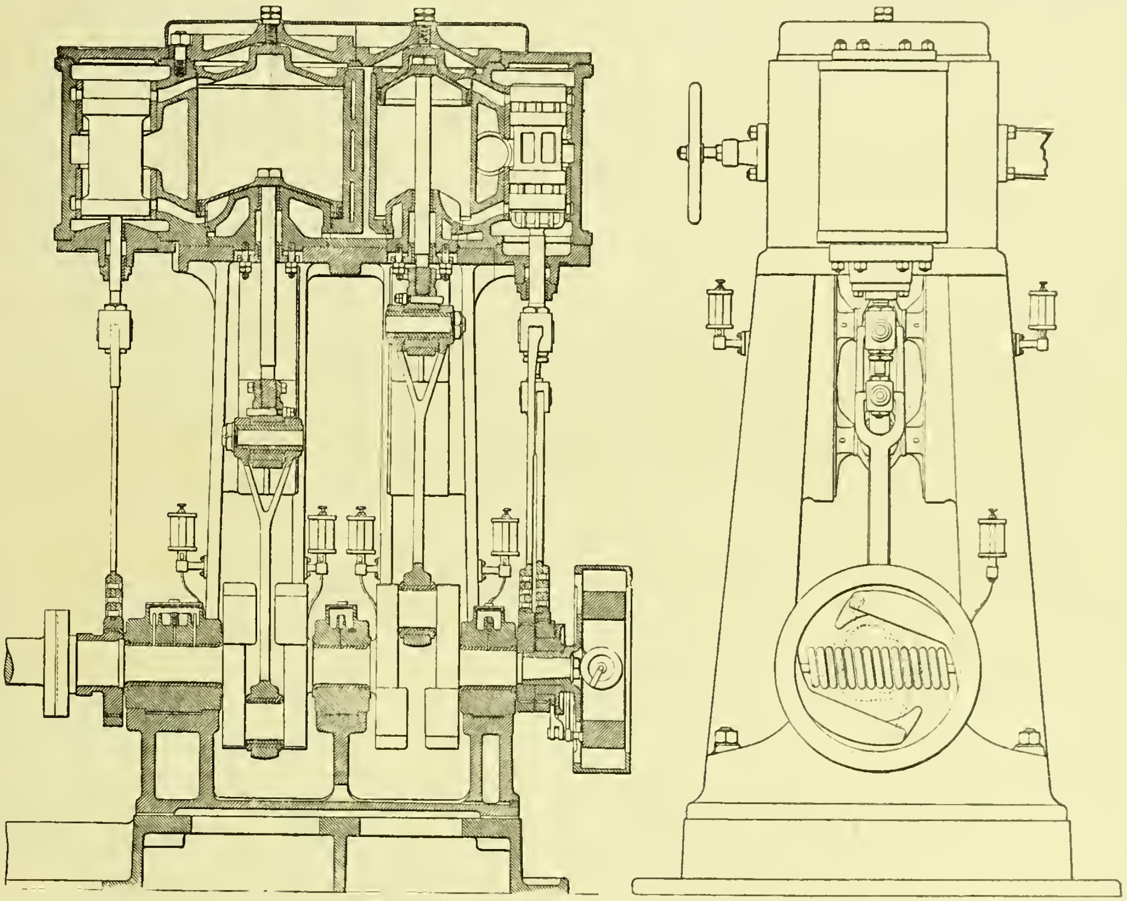
Electromotive Force. By this is meant the electrical pressure that a battery or a dynamo can get up. The higher this electrical pressure is the greater is the current that the dynamo or battery can send through a given resistance.

Volt. The volt is the unit used in estimating electrical pressures. An ordinary Daniell's cell—or a cell of gravity battery, such as is used in telegraphing—is capable of giving an electrical pressure of almost exactly one volt. The pressure (or electromotive force) giving by dynamos varies greatly with the style of machine and the speed at which it is run. Edison dynamos give about 110 volts, and Westinghouse dynamos about 1,000 volts. The word "volt" is taken from the name of an early Italian experimenter—Volta.

Electrode. This term is used rather loosely, and may be considered to mean the same as the pole of a battery or a dynamo. Oftentimes it stands for the metal plates or wet sponges that are connected to the poles of the battery or dynamo and applied to the person under treatment.

Wheatstone's Bridge. This is an instrument devised by Wheatstone, an English electrician, for measuring resistances.

The confusion that exists in the public mind in connection with these electrical terms comes not only from their newness but also from the unintelligent way in which newspaper reporters and even editors use them. Thus an article lying before us at the present moment, which professes to straighten out some of the crookedness associated with them, contains numerous references to *currents* of such and such a number of *volts*—expressions that are quite meaningless, since currents cannot be measured in volts. *Resistances* are measured in *ohms; currents* are measured in *amperes; electromotive forces* (in other words, *electrical pressures*) are measured in *volts.* When we read about "1,000 volts of an alternating current" being fatal to life, we must understand that what the writer meant to say was that "the current of electricity that will be caused to flow through the human body by an alternating electrical pressure of 1,000 volts" is fatal to life.—*The Locomotive.*



A GERMAN COMPOUND ENGINE.

The engraving represents a class of engines which will be found useful for many purposes, steam launches in particular. It is very light, very simple and easily constructed. It will be noticed that the cranks are 180 degrees apart instead of 90 as usual; this arrangement permits of direct exhaust from high to low pressure without the intervention of a receiver. *Industries,* from which paper the engraving is taken, says: The engine is of 200 h.p., and runs at 180 revolutions per minute, the boiler pressure being from 8 to 10 atmospheres. Both the cylinders have piston valves worked by eccentrics, the high pressure cylinder having two eccentrics working concentric valves, the distance between them or their relative positions being determined by means of a governor placed inside the smaller of the two flywheels. This governor changes the position of the eccentrics on the shaft, and thus determines the point of cut-off. Any kind of valve may be used as well as the piston valve.

◆

Mr. W. F. Stanley asks a question which requires a diagram to answer intelligibly. It is too late to prepare one for this issue, and it will have to be laid over until the next.

ELECTRIC METERS.

House mains receive their supply through a meter which keeps a register of all the electricity traversing it. The electricity on entering the meter has two paths open to it, one by wavy metal strips above, and the other through coils of wire and bottles beneath. The proportions of these are so arranged that the strips conduct, let us say, one thousand times better than the coils and bottles, and, as electricity always divides between two paths in the exact ratio of their conductivity, the quantity which passes through the strips will be just one thousand times as great as that passing through the bottles. These latter are filled with a weak solution of zinc sulphate, and each contains two zinc plates about one inch square. In obedience to laws discovered by Michael Faraday, fifty-five years ago, the electricity which passes through this bottle from one zinc plate across to the other through the solution, causes a certain quantity of zinc to be dissolved from the plate it leaves, and the same quantity to be deposited on the plate it reaches—the quantity of metal so transferred bearing an invariable known ratio to the electricity that has passed. These bottles are removed and replaced every month, and the change of weight in the dried plates compared after the lapse of that term. The amount of zinc found to have been transferred then determines the quantity of electricity that has passed through the bottle, and one thousand times this quantity has entered the house through the metal strips during that time. There is thus no machinery to get out of order, no moving parts to clog, or friction to overcome, and with the bottles exchanged every month the meter itself is almost imperishable. — *Scribner's Magazine.*

◆

Three or four days before Christmas a box of cigars came into the office of a master mechanic in Ohio, on whom we were calling at the time. The present was marked with the name of a certain oil company. The box was of pasteboard made in faraway imitation of red cedar. Our friend made an excuse that he was not smoking at all just then, and insisted that we should try the cigars. (It is only fair to him to say that in all other respects he treated us most hospitably.) They were wholly and superlatively bad. Of the evil character of that transaction there can be no doubt. No superintendent of motive power, master mechanic, or purchasing agent, will sell his conscience for a hundred cigars of *that* brand.—*Master Mechanic.*

◆

Don't bind your son as an apprentice to a poet. One of the leading craftsmen in this line announces his income from his trade in 1889 as $306.25 for thirty-eight poems. The name of the successful poet—for he is successful beyond common writers of verse—is not given, but it is familiar to readers of the best periodical literature, for his verses have appeared in all the magazines that are read by cultivated Americans.

◆

As between poetry and potatoes, raising the latter is by far the most profitable profession.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

CONDITION OF MARINE ENGINEERING ON PUGET SOUND.

Editors Engineer :

I take the liberty of informing the readers of The Engineer of some of the fraudulent and lying schemes resorted to by managers, owners, and captains of steam vessels on the waters of Puget Sound, to avoid carrying a full crew for night and day running, and, more especially, only one engineer, who is expected to place a fireman in the position of an assistant engineer, and become an accomplice in violating the United States steamboat laws in order to hold his job. The manner in which they manage to carry only one engineer is that when the steamer is ready for inspection they will go before the Board of Local Inspectors and make a statement that they will not run the boat day and night, but only twelve hours, or until they get a suitable anchorage. But just as soon as the certificate is granted requiring only one engineer, they never anchor or lie at the dock no longer than to take fuel, water or freight, and in nine-tenths of boats of that class the engineer fires his own watch. There are 52 steam vessels out of 150 on Puget Sound exclusively that carry only one engineer, viz.: 11 passenger steamers, from 75 to 115 tons register; also 12 tugs and freighting steamers of the above register; and 19 of the same class that register from 10 to 15 tons. There are also 10 passenger steamers that register from 8 to 50 tons that run from 9 to 12 hours on their respective routes, and then do towing from 4 to 10 hours additional, and about 75 per cent. of the engineers do their own firing. The 21 passenger steamers carry on an average 375 persons per day between port and port. About one-half of the above mentioned steamers have captains that are either self-conceited, domineering ignoramuses, or chronic periodical drunkards, who have no respect for themselves or anybody else. The height of their ambition is to keep full of liquor, and assume that they are the only person aboard the steamer that is endowed with intelligence.

Among this class of owners, managers and captains, the engineer is considered as a part of the machinery; he needs norest, he ought to be able to eat slop, and sleep in the bilge, if he should have an opportunity to do so, once in 24 or 48 hours. Every engineer on Puget Sound who has been employed on asteamer, where he has stood in the engine and fireroom and worked against two men at the wheel from 18 to 48 hours, knows this to be no exaggeration. When the class of owners mentioned become so universally known among engineers that they cannot get an engineer to go on their boats, they will get some amateur fireman, or a saw-mill man who has fired and run an engine for about three or six months, and through fraud and perjury they get a special license for him. All they require of their victim is that he shall make an exaggerated statement of his experience in his application for a license, and have the nerve to swear to it. As regards signers on the application they will have no trouble, as that class of men have license generally for both positions, as pilot and engineer. If they cannot get a special engineer made, they tell the victim that *they* have an engineer's license and that he can run on their boat under their license. Nine times out of ten the amateur accepts the position, and the boat is sent out in the vicinity of some large saw-mill, and very seldom comes into a regular port in the daytime. That is the way they manage to run boats without an engineer in the district of Puget Sound. I say that we have a class of managers, owners and captains that cannot be excelled as schemers of the most dishonorable class. They will violate the steamboat laws in every conceivable manner in order to save or make a few extra dollars. They carry giant powder on passenger steamers, and endanger the lives of all on board because they can get a good price for a small bulk. I have been told that they conceal it sometimes in baled hay, sacks of grain, etc., etc. An engineer who would dare to assert his rights would be boycotted. There has been a few instances wherein both engineers and captains have been compelled to report violations of the steamboat laws in order to exonerate themselves from being held responsible for acts they were compelled to do to make a living. But the reports were never acted upon. You can judge the class of custom officials, and others, if your readers remember the great opium smuggling combination that was exposed through the bitter opposition existing between Democratic and Republican officials four years ago. I refer to the smuggling case to show how powerless we are to oppose the steam vessel owners, managers and captains who combine to make the marine engineer a slave for them, who, they consider, should not only work day and night without sufficient rest, but also overweight the safety-valve, and carry whatever pressure of steam that they tell him to. If he refuses to comply with their requests they will use every means to villify and slander him, and secretly boycott him.

There are numerous cases here where the hulls or machinery are not fit for service, but by fraud and lying to the inspectors they manage to get them passed. The inspectors of this district have work enough to keep a half-a-dozen men busy, instead of two men, as at present. And their pay is insignificant for the extended duties that they have to perform. Their salary is but little better than a fireman's on a seagoing steamer. This is an injustice to the inspectors on the part of the Government. The district of Puget Sound embraces the waters of Alaska and Gray's Harbor, a distance of about twelve hundred miles, between the extreme points on the coast line, besides the numerous tributaries of Puget Sound, and inland lakes and rivers.

There are many other grievances that the marine engineers have on the waters of the Northwest. But I do not wish to tire the readers of your valuable paper by enumerating them all. I have been getting The Engineer through a newsdealer for a year or more, and I admire its fearless and independent manner of expressing itself, and also the espousal of the marine engineers cause. I consider it the best, and the most independent and straightforward paper that I have ever read. Every engineer should consider it his friend and instructive companion. By taking the paper and reading it he will find it a source of pleasure as well as of instruction, if he loves his profession. Hoping you may enjoy health, happiness and prosperity from the present until the last act in the drama of life, I subscribe myself your humble servant. Viesta.

[Our correspondent has our thanks, and through us the thanks of all engineers, for his recital of facts as they exist in his district, and if all would do the same, without fear or favor, there is no doubt but that a very great pressure would be exerted against the steam vessel owners who are guilty of the practices named. As we have before stated in The Engineer, there is urgent need of legislation in behalf of marine engineers, or, if this is considered class legislation, there is ample opportunity for some one to arise and provide measures of relief. We say "some one," and are only too well aware of the weakness of the phrase. Who will bell the cat? There is no doubt but that engineers are imposed upon in certain remote districts of this country, and there is no reliance upon public men—Congressmen or others—for relief. These last are bound up in interest with the steam-vessel owner, and will do nothing adverse to him. The only relief that will be effectual must come from the engineers themselves. United they can stand; divided in interest they cannot hope for a change. A change must come in the interest of all concerned, and when we consider how much can be done by concerted action, it is in that direction we must look. We cannot say more publicly.

The Board of Supervisors of Steam Vessels meets in January of each year, but there is no relief to be expected from them. Public opinion bears on them as well as others. They are only individuals working for Uncle Sam, and they return to private life just so soon as they refuse to obey the interests of what they consider the higher power—that is the steam vessel owner. John Smith, Supv. Inspector Steam Vessels, becomes Private John Smith, of the rear guard, so soon as he undertakes to stand up for marine engineers. John Smith is not going to do it, and it is of no earthly use for individual marine engineers to prefer complaints against steam vessel owners. They bell the cat, or try to, and only get scratched or lose their heads for their temerity.

"United we stand, divided we fall."

◆

FROM HURONIA MARINE ENGINEERS' BENEFICIAL ASSOCIATION No. 48.

Editors Engineer:

At a meeting of Huronia Marine Engineers' Beneficial Association No. 43, held Thursday evening, Dec. 27, 1889, the following officers were elected for the ensuing year: Past President, Henry Burton, President, James H. Fitzgerald; Vice-President; Henry Odette; Recording Secretary, Wilbur P. Boynton; Financial Secretary, George H. Bowen, Corresponding Secretary, Eli Swartout, 210 Fort street; Treasurer, John H. Hogan; Chaplain, Peter Finney; Conductor, Almon J. Holmes; Doorkeeper, Andrew Wilson; Trustees, Eli Swartout, John H. Hogan, Arthur Armson; Representative to National Convention, Henry Burton; Alternate, John H. Hogan.

We have renovated our rooms, and have everything in good order, and No. 43 starts out on its winter's business under the most favorable circumstances. Our reading-room is established for the winter, and from the observations that I have been able to make during the past two winters, I consider it a grand success, and, taken from a temperance standpoint, a move in the right direction; the members meet there daily (Sundays excepted) and enjoy themselves after their own way, and it is the opinion of all the brothers that they derive more true enjoyment at the rooms and experience more real pleasure than they could by making a saloon their resort, and it also has a tendency to keep them away from the tempting influence of the saloon element. Why, Mr. Editor, it would do your heart good to drop in and see what a good time the boys are having. We extend a cordial invitation to all brothers who visit our city to call on us. Will say that we have a brand new latch string and it always hangs on the outside. All the leading mechanical and daily papers may be found on our reading table; the only fault found with The Engineer is that it don't come often enough. Eli Swartout, Cor. Secretary.

Port Huron, Mich.

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SUMMONS.

City of Port Huron, }
County of St. Clair. } SS.

Huronia M. E. B. A., No. 43, }
Plaintiff. }
vs. }
Egbert P. Watson and Son, }
Defendant. }

To the above named defendant:

It is hereby ordered and commanded that you shall, on Wednesday evening, January 15, 1890, appear in your own proper person (accompanied by your ladies), at the Palace Hall, in the City of Port Huron, County of St. Clair, then and there to show cause why you should not take part in the Seventh Annual Ball of the Huronia M. E. B. A., No. 43.

And herein fail not on your peril.

Given under our hands and seal, this sixth day of January, in the year of our Lord, one thousand eight hundred and ninety.

Geo. H. Bowen,
W. P. Boynton,
A. J. Wilson,
Committee.

[The defendant in the above action acknowledges service and asks the indulgence of the Honorable Court for apparent disobedience. The defendant aforesaid pleads inability to shake a leg in the mazy, and further pleads that, by reason of increasing years, the light fantastic toe has become a delusion and a snare to him, all of which he puts forth as a reasonable and proper excuse for apparent disobedience of the Honorable Court's summons.]

◆

TO BECOME A MARINE ENGINEER.

Editors Engineer :

Would you kindly, through the columns of The Engineer, give me some practical advice upon the best plan to adopt to become a marine engineer.

I am a machinist and toolmaker, aged 24, and have had some experience in railroad and stationary engine work; have also done a little general reading upon engineering. Also please name some books that would help me—those that would be readily understood by one of common education. Would my size (height, five feet five inches: weight, one hundred and twenty pounds) be a serious objection to adopting that profession. Mere physical strength doesn't always count, and I should try to make my head make up the deficiency. E. H. S.

[There is only one way to become a marine engineer. This is to begin at the bottom and work up. Apply to the superintending engineer of any steamship or steamboat company, and present your qualifications. There will be, as there always is, very many ahead of you, but if you are willing to wait and take your chances, your turn may come. Our advice is not to wait, but turn your attention to other things which pay better without waiting so long. Our correspondent's stature is not an absolute bar. Reed's Handbook is the very best work on the marine engine for the general student; price, $4.50.]

◆

FROM MARINE ENGINEERS' BENEFICIAL ASSOCIATION, No. 61, BROOKLYN, N. Y.

Editors Engineer :

The list of officers elect of M. E. B. A., No. 61, for the ensuing term are as follows: Past President, Thomas McDonough; President, R. G. Davis (4th term); V. P., David Anderson; Rec. Sec., C. de Loraine (4th term); Fin. Sec., Chas. J. Galloway 5th term); Cor. Sec., R. G. Davis, 54 Wall st., N. Y. City (2d term); Treasurer, H. H. Hungerford (3d term); Chaplain, John C. Hanafey; Conductor, Edw. McCormick; Inside D. K, Chas. H. Haggerty; Outside D. K., William Fish (2d term); Trustees, John S. Boyce, C. de Loraine. Morgan Irving; Rep. to Nat. Con., C. J. Coon (3d term), R. G. Davis. Fraternally yours, in Unity and Friendship,

54 Wall St., N. Y. City. R. G. Davis, Cor. Sec.

◆

FROM M. E. B. A. No. 4. CHICAGO.

Editors Engineer :

M. E. B. A. No. 4, Chicago, at their meeting held December 27th last, elected the following officers and delegates: President, Thomas F. Dowd; Vice-President, Wm. N. Eddy; Treasurer, James Donnelly; Financial Secretary, D. W. Wise; Recording Secretary, E. E. Morris; Corresponding Secretary, Geo. T. Gallavan; Chaplain, G. M. Furness; Conductor, P. H. Quinn; Trustees, M. T. Coughlin, G. M. Furness, Wm. P. Lundy; Doorkeeper, P. Leahy; Delegates to Charleston to attend the convention to meet January 20th, M. T. Coughlin, Thomas F. Dowd. Geo. T. Gallavan, Cor. Sec.

Chicago, Ills.

◆

A person versed in such matters says that the life of piling in New York harbor had more than doubled since oil works were established and sludge acid dumped. He was afraid that the stopping of the dumping was serving to renew the pest of marine worms. Here is a hint for nothing.

E. N. DICKERSON.

E. N. Dickerson, the noted patent lawyer, who died in this city last month, was a notable man in many respects. Physically he was a giant, both in stature and strength. He must have been at least six feet six inches in height, and he was handsomely proportioned. He was a genial man, a fast friend, and a most consistent opponent when aroused. Many years ago a spirited controversy arose between Mr. Dickerson and B. F. Isherwood, then Engineer-in-Chief of the United States Navy. Dickerson was an advocate of high expansions, while Mr. Isherwood took an opposite view of the matter. Steamers were built to prove the merit of both contestants, with results which we do not now remember. The Scotch verdict—not proven—belonged to both sides if we remember right. In the course of the controversy Mr. Dickerson issued a very sarcastic pamphlet, in which he sought to cover his opponent with ridicule. This pamphlet was sent to the *Scientific American* to review. The reviewer happened to be a young man fresh from the Novelty Iron Works, who had more or less acquaintance with the merits of the case, and he opened a battery in the rear of Mr. Dickerson and treated him to a dose of his own medicine. At the time named Mr. Dickerson had an office in the same building, and the paper was scarcely published before Mr. Dickerson came flying into the office as if shot out of a torpedo tube. He wore a Hamlet cloak, and with both arms extended, so that he resembled a huge bat, he made one burst from the railing to the office center, where he wildly strode about flapping his wings, exclaiming: "I just want to see the man who wrote that article. I only want to see him. Just let me see him once." If he had looked sharp he could have seen him, for he was within point blank range, but discretion being the better part of valor, the young man said nothing, and Mr. Dickerson went away.

Dickerson devoted a large share of his life to demonstrating the fact that perpetual motion is an impossibility, and that you can't get something for nothing in mechanics any more than in the dry goods business. He heard what a young friend had to say for his invention, and saw at once that there was an impossibility in it somewhere, but he said nothing, and went around to look at the machine. The inventor started it up, and a big flywheel began to revolve with tolerable rapidity.

"How much power do you say there is there?" asked Dickerson.

"Six horse-power."

"And how many cells in your battery?"

"Only so many," mentioning a very small number.

"Huh!" was the lawyer's only spoken comment; but he walked up to the big flywheel, seized hold of the spokes, and stopped it dead in a moment. The inventor cried out in alarm that he would be hurt.

"Oh, don't be alarmed," said Dickerson, "I stopped a ten-horse power one last week," and then he gave the wheel a whirl backward that set it going that way for a moment almost as fast as the supposed six horse-power had been turning it the other way.

Mr. Dickerson was an amiable man in all relations in life, and as a patent lawyer had no equal.

◆

This is a notice of a recent invention to prevent collisions on railways: The apparatus consists of a serious of air chambers connected to telescope together and permit the air to be gradually driven out, and mounted on a suitable rolling support, which may be near to, or removed some distance in advance of, the train by the folding or unfolding of the telescoping sections. * * * Any desired number of air chambers may be employed, five being shown, and preferably of a length of about five feet each, so that when drawn out they will extend some distance in front of the train.

TO REMOVE THE SCALE-PRODUCING PROPERTIES IN WATER BEFORE IT GOES TO THE BOILER.

Many devices and methods have been used for preventing scale in boilers, by the use of various chemicals being placed in the boiler and also by heating the water with and without the use of chemicals, on its way to the boiler.

The most perfect and positive system ever introduced, whereby the water is treated in the cold before it goes to the boiler, and all the scale-producing properties are removed from it, is that of the National Water Purifying Company of 145 Broadway, New York, and their process and system is as follows:

The water to be used in the boiler is first run into two large tanks; two are used so that when one is being injected into the boiler the other can be made ready for same. In these tanks a certain proportion of lime, or other chemical necessary to remove the scale-producing properties, is mixed with the water, and allowed to stand, say, five hours, more or less. It is then taken up by the boiler feed-pump, and forced through the National Filter, which removes the sediment produced by mixing the chemical with the water in the tanks, and after passing through the filter, the purified water goes to the boilers.

If a heater is used, the water can pass through it also, either before or after passing through the filter, but preferably after.

By this system, when the water reaches the boiler, there is nothing in it that would produce scale.

The National Water Purifying Company pursue the following course in contracting for boiler feed purifying plants:

A sample of the water must first be submitted to them for analysis, so that they can ascertain what the objectionable properties in the water consist of. Then they give a formula for mixing, in the proper proportions, whatever chemical the analysis demonstrates as necessary to remove the scale-producing properties from the water, and quote price of the filter, the capacity of which depends upon the size of the steam plant for which the water is to be treated.

In all cases they guarantee the results to be satisfactory or no payment will be required.

They have been treating hard waters for the last two years with complete success, also mine waters, and we would advise our readers who are troubled with hard waters, or any waters producing scale, or other matter that would be detrimental to boilers, to put themselves in correspondence with the above company.

In addition to boiler feed waters, the National Company is purifying the entire water supply of some twenty cities throughout the country, amongst them being Chattanooga, Tenn., (5,000,000 gallons daily capacity, which is the largest mechanical filtering plant in the world), and Terre Haute, Ind., (3,000,000 gallons capacity), which is now in the course of erection. Caldwell, Kan., is the last city that has adopted this system.

◆

The ability of the '*Yorktown*' to steam 200 miles a day, run her electric light plant, distillers, and auxiliary engines, on a total consumption of only nineteen tons of coals in the twenty-four hours, is deemed more than satisfactory.

Those acquainted with the personal abilities of Chief Engineer Andrade of the '*Yorktown*' say that he is not the man to praise an engine unless it deserves it, and his summing up the '*Yorktown*' machinery performance as wonderful is deemed worthy of more than passing note.

◆

Anyone having the issue of November 28, 1885, of *The Mechanical Engineer*, with the engraving of the engines of the '*Chicago*,' U. S. N., in it in good condition, will receive $1 for it at this office.

BADLY DESIGNED MACHINE TOOLS.

A writer in the *National Car Builder* points out a common fault with some machine tools:

"Then take this drill made by the same concern. They have put a left-handed worm on the feed-gear, which necessitates the crossing of the feed-belt. As the distance between the spindle and the feed-cone centers is not more than eight or ten inches, that belt gives no end of trouble, for it is almost impossible to get a lacing that will not tear out. If they had only made the worm right-handed, the belt would be open and we would be happy.

"But when it comes to repairs, just deliver me from that wheel borer. It is a splendid machine, except for that; but they have put such a tangled mass of worms and gears on the feed spindle that it takes an hour to get it out. For example, the nest of gears that drives the feed is on a spindle bolted to the body of the machine. Next the gears, and keyed to the same sleeve with them, is the belt pulley. The only means of oiling this sleeve is through an oil hole in the pulley at one end. As the sleeve is some ten inches long, the oil-way along the bottom of the spindle is easily clogged. Now, notice that the larger gear, on this otherwise easily removable sleeve, is on the inside, so that the nest below on the feed spindle must come off first; but these are slipped over the spindle from the other end and held by a collar rigid with the shaft, so that the whole shaft must come out. Here we find that the oil-drips under the worms on this shaft are so large that they strike the worm gears as the shaft is drawn back, so these worm gears must come off first. Consequently, we must tear the machine to pieces in order to remove a nest of gears that would come off without the slightest difficulty if it were turned around end for end, and there is no good reason why this should not be done."

◆

The United States licensed steamboat captain is a man who has spent years in acquiring the experience necessary to fit him for his calling, and in consequence one seldom meets a man in this body much under forty years of age. In and about the city of New York there are no less than 2,500 United States pilots, while it is safe to say that over 8,000 can be found along the Atlantic coast from Eastport to Key West. Nearly, if not all, of these pilots are members of the Brotherhood of United States Licensed Pilots, an organization which in New York and vicinity has a membership of 1,500. To act as a United States pilot it is necessary to have a license issued by a United States Commissioner, and this officer will not issue a license unless the applicant's claim is signed by at least three regularly qualified pilots. Though at first one might infer that such countersigning was simply a question of having three friends who might be prevailed upon to sign their names, it is really the highest recommendation the candidate could have. No United States pilot will risk his signature to an application, even if it is that of his own son or brother, unless permission to do so is first received from the harbor to which he belongs. As it is, an applicant sends his name through some pilot to the nearest harbor, a committee is at once selected to examine the man, and if the application is for a coast license the examination often lasts for days. Should he pass the ordeal, his application is signed and stamped with the seal of the harbor.

◆

Mr. C. M. Bilderback, a member of No. 13. M. E. A., Philadelphia, Pa., and an expert engineer and machinist, died recently of heart disease in Philadelphia. Bro. Bilderback was past representative of No. 13 at conventions, and was held in great esteem by his associates for his unassuming, sterling character. He will be greatly missed.

◆

Read the letter from Puget Sound, this issue.

THE ENGINEER.

FORTNIGHTLY. · · · $2.00 PER ANNUM.
Foreign Subscriptions, - · · · - · 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, JAN. 18, 1890. No. 2.

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To prevent misapprehension, we respectfully inform all friends that we do not open accounts on credit with any one for subscriptions; these are absolutely cash with order, to all and singular. We make no exception with publishers or agents, and will not open book accounts for small sums sent casually.

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Entered at the New York Post Office as Second Class Matter.

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CONCERNING ORGANS.

FROM time to time several well-meaning persons have urged us to make THE ENGINEER an organ of certain associations, believing that through this means its influence would be extended and that increased financial returns would be noticable. To these suggestions we have listened respectfully, for all hints of whatever character coming from friends are entitled to careful consideration. We have never been convinced, however, of the propriety of the course alluded to. We have had as much experience in this line as falls to the lot of ordinary men, and, without boasting of any special perspicacity, we must say that we have yet to see the first organ of any trade or any association which had any influence or any status whatever. Organs must necessarily reflect what the association it professes to represent wishes them to; otherwise they are not organs. Now a paper so conducted has no independence and no originality whatever. No consistency even, for no association adheres to one line of conduct. One board of managers or trustees starts out with a policy which they think is going to win, the next board has some other policy, consequently the views of the paper are always changing, and no one knows what to think about it or what its course will be in any given direction. Moreover, associations do not always agree, and members become disgruntled upon the slightest grounds. They fly to the editor of the organ and demand a hearing, and if they get it they stir up strife and contention all through the association. If they do not get it they have a grievance, and go around doing all the harm they can. That is human nature.

We repeat that organs have no influence and no status; they are mere public circulars which contain no news or information of any kind. They do not even contain news of the association of any value, for the private business of associations is not published for everyone to read, and the mere fact that one or more lodge has been added to the body politic is not of thrilling interest, or of so great importance as to demand the establishment of an organ to print it in.

Now as to the support any organ would get that is a matter which no one can foresee, much less can it be pledged in advance to any journal. All men do not like the same kind of a paper, and no man can, or should be compelled to take a journal he does not want. The support of an organ would be wholly inadequate to the outlay upon it. This last has to be met at certain periods, whether the organ makes any money or not, and the income of an organ is too uncertain to rely upon. One of the largest engineers' associations, the Brotherhood of Locomotive Engineers, has a little volume published monthly, which is called an organ, and is such in fact. Its contents consist of a directory of the several divisions of the order and some doggerel verses. We have looked in vain in it for anything of interest to the general reader. It is edited in a perfunctory manner, and is altogether a waste of time to read and of money to print. All organs are of a similar character, save that many of them are devoted to the adulation of some one or two men in the order, who have an itching for publicity and notoriety.

Advertisers do not want organs to publish their wares in. Just tell them that such a paper is an organ and that decides the question for them. They know better than anyone else that their trade depends on the general public and that organs never reach it. They prefer to advertise in public journals which are seen of all men.

THE ENGINEER will never be the organ of any special society, but it will at all times, as it always has, in fact, continue to represent the best interests of all engineers, in or out of associations, for in this way it can best serve the interests of its constituents of all classes. No organs are needed.

ENGLISH CAPITAL IN AMERICAN MILLS.

FROM time to time, as our readers are aware, the daily papers have chronicled the sale of mills and factories of all kinds in this country to English capitalists. The prices paid for these properties are seller's prices, that is to say, the sellers did not need to sell, but the buyers were determined to buy, consequently they paid long prices for the properties. The object of the buyers was, of course, to place English money in America, where it would earn a much higher rate of interest than it would in England. The average earnings of certain prosperous concerns in this country, seem, no doubt, enormous to English capitalists, but there is no certainty that under English ownership these earnings will continue in the same ratio, or anything like it, even though the American management of the American mill is retained on salaries.

It is not in human nature to take the same interest in a plant of which the ownership has reverted to others, and of all others—foreigners. Therefore, it is unreasonable to expect that the fat dividends so confidently looked for by English capitalists will continue for very long. The *Commercial Bulletin*, of this city, takes a similar view. It says:

"To Americans there can be no objection to this new drift of investment. It enables them to sell their properties on highly favorable terms, leaving them free to devote the proceeds to the procurement of new and better plant at a cost much below that at which the British have made investments. In the hope of shutting off the competition, which these transactions naturally suggest, British buyers have sought, as far as possible, to keep the original owners interested, and have secured their co-operation in the new management, and obtained their pledges not to create new establishments in the same lines of trade. But these are flimsy protections. The temptations are too strong to be restrained by pledges or common commercial honor, and there can be no difficulty in doing through 'doubles' what cannot be done more directly. As to the prospects of the investors, it cannot be denied that for the most part they have selected sound, prosperous establishments; and in some cases they will stand in a position for almost controling their particular branch of trade. But they must expect to meet a sharp competition, and into that they enter heavily handicapped. They have paid immense premiums for plants. They have bought 'goodwill' at very heavy cost, and yet that is an indefinite something, worth nothing unless it is found practicable to hold permanently what it conveys. They have to manage at a distance of 3,000 miles from the factory, and, probably, largely through foreigners, who know little of the things on which success depends. Considering the large price given for the properties, and the profits of the negotiators and intermediaries, the capital on which interest has to be earned is perhaps nearly double what it would have been in the case of starting new establishments. These are fundamental difficulties, and it will require great care, ability, and economy of management to earn dividends sufficient to satisfy even the very moderate expectations of Britishers."

We shall doubtless witness at an early day an influx of English "managers," who will come over here with the expectation and belief that the methods which have succeeded in England will answer in this country also. They will be greatly disappointed. Nothing is better established than the business customs of certain sections, and the routine red tape, and rigmarole generally, which John Bull loves, is heartily detested here. We fear John's dividends on American properties will grow small by degrees and beautifully less, but we shall be glad to find that our prognostications are incorrect. We have no prejudices against John and his investments.

THE OBJECT OF CRITICISM.

WHAT is the object of criticism? In the minds of many it is only to point out flaws in the work or characters of others for the purpose of hurting their sensibilities, or, in other words, to make them feel badly. This seems a very hasty and superficial view to take of the subject. Ridiculing things is not criticising them, and criticism is not ridicule; when it degenerates into that it accomplishes nothing. The object of criticism is to point out weaknesses or defects as they appear to the critic, and there is no ill will involved, and no desire on his part to belittle anyone. Suppose we make a certain structure, and it is too weak for its work. It is the roof of a depot, let us say, and the walls it rests on are too unstable to support it. The architect does not intend to kill us if we go into his house, but he will all the same unless he strengthens the structure. Now what is to be done about it? Shall we tell our friend civilly why his work is dangerous, or shall we go somewhere else and avoid him, letting others take their chances. Shall we "criticise him," so to call it, or shall we pass by on the other side, shrugging our shoulders with the remark that it is none of our business? We say the right course is to warn the architect that all experience teaches that he has not put stuff enough in his building, and that all who use it are in danger of their lives. Criticism of the legitimate sort has its use, and none of us is beyond it. It is idle to say that men are infallible and that because they have made no gross blunders as yet, that they never will. There are times when the clearest headed men are prone to error, and no one is exempt. The able, conscientious critic, is a public benefactor, and should be respected for the pains he is at to point out mistakes.

MACHINISTS' SMALL TOOLS.

THE machinist of thirty years ago, who took his noon hour, or an occasional hour out of the company, to make a few simple tools, calipers, squares, gauges, etc., is amazed when he looks at modern small tool catalogues, and sees what is now to be had ready made, far better than the machinist can make them by hand. The array of instruments of precision, so called, for machinists' use, is simply astonishing, and they go far to insure better workmanship than was the case a third of a century ago, in so far, at least, as the detection of errors is concerned. The workmanship, of course, remains with the man himself, as it always did. The tools do not do any work themselves. Nevertheless, the aid they afford is very great. Many of us remember the vagaries of the boxwood rule and its uncertainties. The mysterious misfits which occurred at times often led to the question from the foreman, "What kind of a rule have you got?" investigation proving nothing in particular, since it did not help the misfit any. The steel scale generally in use nowadays is practically uniform as to graduation the country over, and having a black mark on a white surface, is more easily seen than a gray mark on a yellow (or dirty brown) surface. We think modern machinists have a great advantage over their predecessors in the matter of small tools.

THE EDITOR'S COURSE.

AT this season the editor in general puts forth his manifesto, and tells people what he is going to do, and it is interesting to note that they all have entirely different views as to what is the one thing needful to insure success. One contemporary says it is "information" that people want, and he utters a great truth—but what kind of information? What is information? News or knowledge to some is not so to others. Professors do not care for the A B C of science because they find it wearisome, and beginners do not care for more advanced studies because they cannot understand them. Where, then, shall the line be drawn? That is a difficult question to answer. We find this ready at hand as a sample of information; it really is that to some, but the experienced engineer who finds his paper publishing such matter constantly is apt to think that the editor has no definite object in view. To wit:

> "Do not let your ashpit fill up; if you do you will burn and warp your grate bars.
>
> "See that the water column does not fill up; blow very often from the bottom; shut the steam connections on the top so that the pressure will all come from the bottom, and clean out all sediment that may be there."

If an editor starts with the intention of pleasing everyone, regardless of their intellectual status, he is certain to fail, because he essays an impossible task. The wisest course would seem to be to furnish a class of matter which is useful to intelligent readers and seek a market for it among them, regardless of the small circle who are not intelligent. We do not all think alike in this world, and it is fortunate that we do not; it would be a monotonous existence if we did, for we find food for thought and reflection in the very differences between us, but we can all understand an intelligent discussion of any given subject and appreciate it while we differ from it.

We hope all the editors who have laid out their course for 1890 will make safe harbor.

FAMOUS AMERICAN ENGINEERS. No. 4.

CHARLES W. COPELAND.

CHARLES W. COPELAND was born in Coventry, Conn., in 1815, and at the age of 14 years was an apprentice in his father's (Daniel Copeland) smith-shop, who was a builder of steam engines and boilers in Hartford, Conn., on the premises recently occupied by the Woodruff and Beach Iron Works. Charles W. Copeland subsequently went through all branches of the work, pattern shop, turning and fitting, and boiler making. In 1832 he was made foreman of his father's machine shop, and while occupying that situation there were several marine engines built at the shop for vessels on the Connecticut river and Southern rivers. In 1836 he accepted the position of engineer of the West Point Foundry, in this city, the place having been formerly occupied by Adam Hall, where he remained until the fall of 1839. While with the West Point foundry there were many marine engines built at these shops; notably those for the United States naval steamer '*Fulton*;' steamboats '*Utica*,' '*Rochester*,' '*Swallow*,' '*Milwaukee*,' '*Cleveland*;' and ferryboats '*Gold Hunter*' and '*Jamaica*,' the '*Bunker Hill*' and the '*Lexington*.' Also, the first iron hull steamboat built in the United States, that plied on Lake Ponchartain.

In 1839 the appointment of constructing engineer for the United States Navy was offered him, the same office now entitled "Engineer-in Chief," which was accepted, and shortly afterward he made the plans for the engines and boilers of the naval steamers '*Missouri*' and '*Mississippi*,' the former being built at the West Point foundry and the latter at Merrick and Towne's, Philadelphia, Pa.; and in a few years the engines and boilers for the Naval steamer '*Michigan*' for Lake Erie, the first iron steamer for the naval service. At a later date he designed the engines for the '*Saranac*' and '*Susquehanna*,' also of the United States Navy. Double shell pistons, cylinder heads and bottoms were first introduced on the '*Missouri*' and '*Mississippi*.'

At a later period he was superintending engineer of the Allaire Works of this city, and while there designed the engines for the steamships '*Pacific*' and '*Baltic*,' built at those works; also the '*Panama*,' '*Bay State*,' '*Empire State*' and '*Traveler*,' with the '*Harriet Lane*' for the revenue service.

When the steamboat bill of 1852 was before Congress for consideration, Mr. Copeland was called upon for his opinion on many subjects contained in the proposed law, and was subsequently made the first supervising inspector under the law for the New York district, and remained there for nine years.

During the period covered by the War of the Rebellion, Mr. Copeland was engaged in altering and fitting steamers for the fleets engaged on the shallow waters of the Southern rivers, and it was through his suggestion that many double-enders were brought into use for the intricate channels of those rivers. Since then he has been the consulting and superintending engineer of the Light House Board, and has designed the hulls and engines of all the steam vessels in that service for over fifteen years. Also the steamships '*Albatross*' for the Fish Commission, as well as the '*Fish Hawk*' for the same service. He also designed the machinery for many of the ferryboats of Boston harbor, as well as those for New York waters. Mr. Copeland is still in active business pursuits at his office in this city daily.

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"WITH the best wishes for the success of THE ENGINEER." How many times have we read that peroration to letters enclosing subscription this year? A great many hundred times, and it is a sentence that never wearies us to read. The good wishes of friends are material aid and comfort, and make life blossom as the rose. They are all heartily reciprocated many times. If we live to see all the Happy New Years which our friends wish us we shall discount Methuselah 100 per cent.

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FOR the '*City of Paris*' it is claimed that she has demonstrated that forced draught on the closed stokehold system can be efficiently maintained at sea and give fifteen indicated horse-power per square foot of firegrate area at sea; that twin screws are better than the single screw for high speed vessels; that long ships may be easily manœuvred; that fine-ended ships are good sea vessels, and that comfort and speed are not by any means incompatible with safety.

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IN an elaborate review of the performance of the '*Vesuvius*,' mathematically considered, Robert Mansell of Glasgow sums up with this statement:

"Finally and most important of all, the resistance *most certainly* does *not* vary in the usually assumed ratio of *the square of the speed*. It is this grossly erroneous assumption which has been the source of all the difficulties and uncertainties which have hitherto obscured this most important inquiry—the Laws of Steamship Propulsion."

The italics are Mr. Mansell's.

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THE beautiful model of the '*City of Paris*,' which attracted so much attention at the Paris Exposition and was honored with a gold medal, is now on exhibition at the office of the Inman Line, 6 Bowling Green, where every opportunity will be afforded to examine this superb example of marine architecture.

Foreign and Domestic Trade Literature.

CORROSION AND SCALING OF MARINE BOILERS. No. 2.

If an earthenware trough be half filled with a mixture of sulphuric or any other acid and water, and a slab of zinc and another of iron be placed in the acidulated water, then corrosion of both metals will immediately take place, the zinc being destroyed much more rapidly than the iron, but if we drill a hold into each slab of metal and plug into each of them the cleaned ends of a copper wire then we have an entirely different state of things. A current of voltaic electricity is flowing from the iron through the wire to the zinc, and then through the water from the zinc to the iron, so that the zinc is the positive element and the iron the negative, and the zinc is destroyed in order that the iron may be preserved. Now do away with the iron slab and make an iron trough, fill it half full with the same acid and water and connect the immersed zinc slab to the trough by means of a copper or metallic wire. The conditions are now just the same as before, and the oxidation of the zinc renders the iron impervious to the attack of the acid.

There is no difference between this last arrangement and an ordinary boiler having several zinc slabs being in metallic contact, and we see that by using zinc in sufficient quantity in a marine boiler that electrical protection is not only possible, but very easy of accomplishment.

There is no gainsaying the fact that, if zinc slabs are of sufficient surface, kept clean, and points of attachment to the iron kept clear of any form of oxide, we have an efficient means of keeping pitting in hand and preventing either its starting, or if started, its further spread. Putting slabs in on the bottom of a boiler is of no earthly use, except to the zinc manufacturer.

By far the most rational method of proceeding is to endeavor to prevent the entrance of the acid into the boiler. This is best accomplished by declining to use oil in the cylinders at all, thereby doing away with any fear of damage.

If oil be used, then soda (carbonate of soda) should be given when the water becomes acid. This state can readily be determined by testing a small quantity of the ordinary boiler water with a slip of litmus paper (red). So long as the paper, when immersed in the hot water, retains its red color, the water is acid, and soda should be put in at some convenient place, say at the hot well; when time has elapsed sufficient to allow the soda to get into the boiler, try the water again, and repeat the operation until the slip shows symptoms of turning bluish in tone; enough has now been put in and no fear need be felt as to acids affecting any exposed parts.

Turning now to the formation of scale we have to account for the almost uniform deposition of insoluble matters on the heating surfaces.

Owing to the condition of the heated plates they possess a certain slight attractive power, which is employed in capturing and holding down the minute particles of solid matter which the convection currents bring within the field of attraction; this goes on more or less all over the heating surfaces and is always greater where the plates have the most heat to transmit, for example on the furnace crown and at the back tube plate.

If the temperature of the water is great, this action, if allowed to go on, becomes so energetic as to cause a very rapid and ruinous deposit to take place, and the more sea water we introduce into the boiler the heavier will be the scale, as we are bringing in water laden with insoluble matter or substances capable of being rendered insoluble, and the heated plates immediately capture them, to the risk of everybody and everything.

From what has been said, it will be evident that the best method to adopt in working a marine boiler with a high pressure of steam, is to see that nothing but pure uncontaminated water is put into the boiler. Avoid, if possible, the use of oil internally, and feed with fresh water, under which conditions a good length of time must elapse before the density reaches say, 2½ or 3.32nds, at which point a boiler under these conditions could be run, or, if compelled to use oil, give doses of solution of carbonate of soda (say 1 lb. dissolved in water) until red litmus paper shows no traces of acid, and keep everything as tight as possible, so that no waste occurs and very little supplementary feed is needed; the boiler in this case may, supposing the supplementary feed to be sea water, safely go up to 5.32nds in density without anything untoward happening.

When steam is done with, allow the boiler and water to cool down together for several hours at least, to avoid baking the muddy deposit into hard stone-like scale.—*W. H. Thorn.*

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SMOKELESS POWDERS.

The smokeless powders consist essentially of nitro-cotton, or other kinds of nitro-cellulose, specially treated with a view of producing a slower burning substance, or of nitro-glycerine and nitro-cotton. The presence of metallic nitrates other than ammonia nitrate, as a constituent of such powders, would be incompatible with their smokelessness.

The Schultze powder, which properly comes under the head of smokeless powders, has been treated of by the *Times* to some extent. It is unquestionably the oldest smokeless powder, but there is not the same degree of smokelessness to it as pertains to the new Lebel powder. The Schultze powder is fully twenty-five years old, but since its introduction all attempts to make it serviceable for use in rifles have been unavailing. It must be remarked, however, that the powder has been toned down several times so that it became sufficiently slow burning for use in rifles, but a slight change in heat or cold so affected it that it very shortly lost its slow-burning qualities. The Schultze powder consists essentially of nitro-lignum with a considerable quantity of nitrates of potassium and barium.

In connection with the Schultze powder comes the well-known "E. C. sporting powder," which consists of nitro-guncotton and a large quantity of nitrate with a little resinous or waxy matter, the explosive being formed into small ground grains. Both the Schultze and E. C. powders give, when fired, a very appreciable amount of white smoke, consisting of carbonate of potassium and barium. Dr. Griffith is laboring assiduously on the Schultze powder, believing that he can yet produce a grade of it sufficiently toned down to meet the requirements of rifles.

In connection with the Schultze powder is a nitrate made by F. Engel, bearing date of 1887. This nitrate is made of vegetable fiber or other form of cellulose in the usual way, and treated with acetic ether or acetone. The claims of higher velocity of projectile, less pressure, and very much less smoke and residue than with ordinary gunpowder, are made for it.

F. C. Glaser's patent of 1887 has the greatest possible similarity to Engel's. The same solvents are used and the same mode of procedure followed. Glaser, however, according to Deering, uses his cellulose in the state of paper or cardboard in sheets or strips, or in other manufactured form, which are converted into nitro-cellulose in the usual way and then gelatinized by the action of a solvent.

E. Turpin's patent of 1888 is also for a smokeless powder. He prepares his paste by dissolving guncotton, more or less nitrated, in a suitable solvent. For the most highly nitrated gun-cotton he proposes as solvents a solution of ammonia in ether or a mixture of acetone and ether. The charge of the new powder, according to the patentee, would generally be half that of ordinary black gunpowder, and would give a higher velocity.

The Hengst powder (smokeless), which is one of the latest nitrates on the market, has been experimented with by Col. Shakespeare, of the British Army, who remarks: "It was said that water produced no effect whatever upon it. What did I do? I soaked two ounces for forty-eight hours, dried it and fired it, and found it was perfectly good. I boiled two ounces for forty minutes, dried it, and it was just as good as before. I steamed two ounces for twenty minutes over copper-wired gauze, and alongside of it I had the same quantity of sporting powder. I fired them without drying them, when the black powder fused, but this powder exploded, only rather slowly."

Regarding the efficiency of smokeless powders there is no question but that it is possible to get the same velocity, if not a higher one, than can be had from the best grade of black powders. In the case of the French Lebel powder a muzzle velocity of 2,034 feet per second has been obtained. This is, perhaps, the highest velocity known in service arms.

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THE DESIGN AND CONSTRUCTION OF CHIMNEY SHAFTS.

Cellular Shafts.—We will now draw attention to a system of building chimneys of cellular brickwork which, though common enough in Germany, does not appear to be much followed in England. Mr. Ward, in a paper read before the Institution of Civil Engineers in 1886, describes a square shaft he had shortly before constructed on these principles at some brickworks in Kent. The shaft is 170 ft. high. The thickness of brickwork in the chimney at the base (allowing for the walls) is only about 12in.; the brickwork generally throughout the stalk is 4½in., the walls being built of cellular work. Web walls 4½in. thick unite at intervals the inner and outer skins, each of which is also 4½in. thick. The web walls are joined together every 10ft. vertically by rough arching or setting over of the bricks. Stability with such a design is easily secured by allowing a large base and giving a good batter to the external skin. The walls being hollow, the base can be built at a minimum of expense, as the weight to be supported by the foundation is small as compared with that which is attained with the ordinary method of constructing the walls solid. This is an important consideration when shafts have to be constructed on soft and yielding foundations. The above mentioned chimney, as compared with one built according to the usual English practice, has taken less than one-half the number of bricks. Another advantage claimed for cellular built chimneys is that there is less cracking of the brickwork, the inner skin being under a similar condition to a separate liner, and free (to a certain extent) to expand or contract, by virtue of the thinness of its walls, without throwing any great stress on the outer skin. The air space between the two skins acts as a good non-conductor of heat, and consequently keeps the outer skin cooler. In Germany cement is generally used to build these chimneys, but the one in Kent was built with exceptionally good lime mortar. The chimney was built from an inside scaffold, and seems to be in every way a perfect success.

Construction of Cap.—On account of the exposed position of the cap, and the deteriorating action of frost, rain, acids and gases, together with the difficulties attending examination and repairs, it is of the utmost importance that suitable and non-perishable materials should be used, and also that the workmanship should be of the highest character. There are four materials at command, viz., stone, brick, terra-cotta, and cast-iron. The two latter are the most durable, and up to the present have been the least used. Whatever material be used, the cap should form one compact mass, thoroughly bound together, so that the joints cannot possibly open. If of stone or terra-cotta (especially if it is desired to have a very ornamental projecting cap), each piece forming the cap should be fixed together by vertical double dovetailed slate or neat cement dowels running the whole depth of the piece; besides this, it should be secured horizontally by strong gun-metal or copper cramps let in flush with the horizontal joint and run with lead. On no account should wrought-iron cramps be used, as they oxidize, swell, and burst the stone; many caps have been split in this way. As a secondary precaution a recess is frequently sunk in a horizontal joint near the top of the cap, so as to form a circular groove, into which a copper or gun-metal ring about $2\frac{1}{2}'' \times \frac{5}{8}''$ is fitted and secured by neat cement. If the projection of the cap exceeds more than three-fourths of the thickness of the supporting masonry, precaution must be taken to have a blocking course above of sufficient weight to counteract any tipping tendency. As to terra-cotta, its advantages and disadvantages for ornamental and plain caps may be summed up as follows:—(1) *Durability*—If properly burnt it is unaffected by the atmosphere or by acid fumes of any description. (2) *Lightness*—If solid, it weighs about 122 lbs. per cubic foot, but if hollow, as generally used, it weighs only 60 to 70 lbs. per cubic foot, or half the weight of the lightest building stone, and is therefore especially suitable where considerable projections are required. (3) *Strength*—Its resistance to compression when solid is nearly one-third greater than that of Portland stone. (4) *Hardness*—Mr. Page found by experiment that it lost by attrition one-sixteenth of an inch in thickness, whilst York stone, with the same amount of friction, lost a quarter of an inch. (5) *Cost*—It is cheaper in London than the best description of building stone, and is easily moulded to any design. On the other hand, terra-cotta is subject to unequal shrinkage in burning, which sometimes causes the pieces to be twisted ; but these imperfections cannot be seen at altitudes of above 70 or 80 feet. Great care must be taken in fixing the blocks ; twisted and warped pieces are sometimes set right by chipping, but this should be avoided, as, if the vitrified skin or surface be removed, the material will not be able to withstand the attacks of the atmosphere. It can be obtained in numerous colors, viz., rich yellow, pink, buff, etc. Terra-cotta which shows small air cracks on the surface should be rejected. Tall chimneys having no caps (in which cases the brickwork is carried to the top) should be effectually coped to prevent the percolation of water into the joints of the brickwork, which during frosty weather has a dangerous effect, the joints being destroyed and the top bricks being left loose and without support. The coping should be purposely made in fire-clay or terra-cotta, about 3in. thick, and flanged over about 6in., both inside and outside the chimney. A cast-iron curb can be used with even greater advantage. Whatever material be employed in a cap, it should be set in Portland cement mortar. Many chimney caps are designed in bricks, and with very pleasing effect ; but still they cannot be considered satisfactory, taking the cap as a whole, on account of the number of parts and joints of which the cap is composed, caused necessarily by the small dimensions of bricks.

Probably one of the most durable and suitable materials for a cap is cast-iron. Its advantages are that the cap can be made extremely light, of any design, and at a very low cost as compared with stone or any other materials—especially when the cap is of an ornamental character ; it can be made in sections of any size or shape, the outline of the design when cast having a clear and sharp appearance. The flanges for bolting the cap together should be cast inside, the joints being made watertight either by red lead or metalic jointing. The bolts for the flanges are usually made of wrought-iron, and sometimes galvanized ; but copper bolts are preferable, as they do not oxidize. If required, the cap can be so constructed as to fix together without any bolts, the sections locking one into the other. Many shafts are provided with cast-iron caps. In designing a cast-iron cap, care should be taken that the shape be such that the center of gravity of each section may fall well towards the inner face or flue ; so that, should the bolts corrode away, the sections would tend to crowd together. The sections must be provided, where they rest on the masonry, with flanges both inside and outside the walls.

(*To be continued.*)

IN FAVOR OF STEAM JACKETS.

As a result of some elaborate experiments with a triple cylinder expansion engine in the Whitworth Engineering Laboratory in 1888-'89, it was shown that steam-jacketed cylinders have a certain value.

The engines in the Whitworth Engineering Laboratory had been throughout specially designed and constructed with a view to the fulfillment of the requirements. There were three separate inverted cylinder engines working on separate brakes, having the following dimensions:

Engine.	Cylinder. Diam. Inches.	Crank-shaft. Stroke. Inches.	Crank-shaft. Diam. Inches.
No. I. (high-pressure)..........	5	10	2¾
No. II. (intermediate)..........	8	10	2¾
No. III. (low-pressure)..........	12	15	4
Air pump on No. III...........	9	4½	
Feed pump "	1½	2	

All the engines had their cylinder walls and both covers separately jacketed, and so arranged that they could be worked with or without steam in any or in all of the jackets. Each engine was designed to carry a pressure up to 200 lbs. on the square inch, to run at any piston speed up to 1,000 ft. per minute, and had expansion gear to cut off from zero up to 0.8 of the full stroke. One engine was furnished with a surface condenser having 160 square feet of surface; the other two engines were furnished with alternate exhausts, either into the atmosphere or into steam jacketed receivers supplying the next engine, each receiver having an alternate supply of steam from the boiler. The boiler was of the locomotive type, with 5 square feet of grate, 200 square feet of heating surface, and carried 200 lbs. of steam per square inch. It was set in a hot chamber, with an economizer having 50 square feet of heating surface, of which an area of 40 square feet was kept clean by scrapers, and was so arranged that the gases moved in the opposite direction to the water. The furnace was worked either with chimney draught or with forced draught on the closed stokehold system, and burnt fuel up to 160 lbs. an hour. The specialty of the system consisted, mainly, in the provisions made to render possible the accurate determination of the manner in which each part performed its work, as well as to make the performances of each organ, as far as practicable, independent of the performance of the rest. To accomplish this, the boiler and three engines had been separated by intervals of 20 ft., 7 ft., and 12 ft., and the steam distributed by five systems of pipes, while the engine shafting extended over a length of 36 ft. This spreading out of the engines entailed greatly increased radiation and additional friction. These quantities, however, being differently measurable, did not confuse the results.

The investigation, commenced in March, 1888, had been continued at the rate of two trials a week during the session, a trial occupying six, four or two hours, and being conducted as regular work in the laboratory. As the trials were intended eventually to cover all possible systems of using steam, each system was fully investigated in a series of trials, giving consistent results, before proceeding to another system. After the first twenty-four trials, a scheme was drawn up, commencing with a series of trials of triple-expansion at 200 lbs. boiler pressure per square inch, with and without steam in the jackets. This series, involving thirty-two trials, was commenced in October, 1888, and completed in April, 1889. Several trials were made at each speed and the results were found to agree within 1 per cent., so that three trials with steam in the jackets and three without were taken as illustrating the results obtained. The conditions under which this series of trials had been made were, if anything, more favorable to economy than any which prevailed in practice; and although the purpose of these engines was to elucidate the causes of inefficiency rather than to realize the utmost economy, yet it was very desirable that the results obtained should not, whether on account of the comparatively small sizes of the engines, or from other causes, fall greatly behind what might be expected from high-class engines in actual practice. Hence it was eminently satisfactory to find that, notwithstanding the drawbacks already mentioned, the economic results compared favorably with anything yet obtained in practice, even with the largest engines. The pounds of coal and of water per indicated horse-power per hour were :

	With Steam Jackets.	Without Steam Jackets.
Coal—Total............	1.50 to 1.33	1.81 to 1.62
Discounting radiation	1.30 to 1.21	1.77 to 1.54
Water—Total..........	14.10 to 12.68	17.30 to 15.90
Discounting radiation	12.30 to 11.90	16.60 to 15.10

Although these results were extremely good, the sources and extents of the various losses were clearly shown. Thus, of the total heat received by the engines, exclusive of radiation, with jackets 19.4 per cent. had been converted into work, and without jackets 15.5 per cent.—the greatest amount which would have been converted had there been no secondary actions being 23 per cent.; so that with steam jackets there were losses through secondary actions amounting to 17 per cent., and without jackets to 34 per cent. The manner of the distribution of these losses was also apparent. One important source of loss, which with jackets accounted for 5 per cent. of the loss, had been brought to light for the first time. This was the heat carried away from the surfaces of the cylinder and passages, in consequence of the expansion after release. The effects of cylinder condensation were clearly shown in the mean diagrams taken from the trials. Although these trials were not in themselves sufficient to determine anything like a complete law of this action, they exhibited in a striking manner its dependence on certain circumstances. One circumstance in particular, which had not previously received much attention, was here shown to be of primary importance in the action of steam jackets. These diagrams showed that with the temperature of steam in the jackets of No. I engine the same as that of the initial steam, the effect of the jackets on the cylinder condensation was very small. In No. II engine, with 80° Fahr. difference in the temperature of the jackets and that of the initial steam, the condensation was reduced from 30 per cent. to 5 per cent.; and a difference of temperature of 180° Fahrenheit between the jackets and the initial steam in engine No. III entirely prevented condensation. Thus, in these trials, with steam at boiler pressure in the jackets, low-pressure diagrams had been obtained, apparently for the first time, in which the curve of expansion coincided exactly with the curve for saturated steam.

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THE Hartford *Post* says:

The *Post* was the first newspaper in the United States to adopt this wonderful invention (typesetting machine) into practical, everyday use, and it is in our own establishment, after more than two years' continuous trial, that the latest small improvements have, from time to time, been added, which now render this, the only practical and simple typesetting model ever invented.

The Burr Company in this city have used typesetting machines for years. Whether they are as good as those in the *Post* we cannot say.

◆

A NEW French invention is a smoke bomb, intended to be fired into the ranks of the enemy, who uses smokeless powder, and obscure his view.

TO PREVENT CYLINDER CONDENSATION.

Professor Thurston, of Cornell University, has recently patented a device to reduce condensation in steam cylinders, and his specification is as follows:

"It is well known that the composition of ordinary cast-iron is largely graphitic, the carbon contained by the iron amounting to from 2 to 3 per cent. of the whole up to 5 or 6 per cent., according as the iron has been exposed to a higher or lower temperature in the blast furnace, and as a greater or less amount of fuel is burned in its reduction from the ore. It is also well known that a process of slow oxidation will remove the iron in part from the surface so exposed and leave the carbon in a somewhat compact form, which is held in place by a honeycombed mass of unoxidized iron. This mixture covers the surface of the solid iron to a depth depending upon the duration of the action of the oxidizing medium.

"One of the best methods of securing the oxidation of the iron is to subject it to a dilute acid—say, for example, a solution of sulphuric acid in water in the proportion of 1 part of acid to 10 of water. A weaker solution and a longer exposure would accomplish the same results. By actual experiment I have found that a piece of iron submitted to a very weak solution of acid for ten days produced good results.

"In carrying out my invention I expose the internal parts of the engine (such as the heads of the cylinder, the two sides of the piston, the internal surfaces of the ports, and the clearance space), to the action of such a solvent for a suitable length of time, thus converting those surfaces into highly carbonized material, which is a poor conductor of heat. It is, of course, impracticable to so treat the rubbing surfaces; but as they are kept in a high state of polish their capacity for taking up heat is greatly lessened, and it is therefore less necessary to treat the surfaces subjected to friction.

"In modern engines, especially those of a 'high speed' type, the cylinders are of large diameter and small length, and the stroke of the piston is short, thus exposing large areas, which are effective in condensing the steam and reducing the efficiency of the engine. These large areas I propose to treat in the manner described to prevent the wasting of heat.

"In some cases, in addition to rendering the surfaces graphitic in the manner described, I shall fill the spongy surfaces so prepared with a substance which is a non-conductor of heat—such as oil, shellac or other adhesive non-conducting materials—which will increase the non-conducting and heat storing properties of the surfaces, and at the same time aid in giving them permanence in the presence of variations of temperature, pressure and humidity, such as inevitably occur within the engine."

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One night, as I was standing on the poop of the '*Hercules*,' a torpedo-boat loomed up on our port beam so close that it seemed as though I could have tossed a biscuit on her deck; we immediately started a rapid fire upon her, blue-jackets and marines working machine guns and rifles with a vigor that must have sunk her had their cartridges been real. We had no sooner started our fire, however, than I saw a silver streak in the water, accompanied by a swishing sound, as of a rattan whipped in the air. This meant that a torpedo had been launched, and as our big ironclad hull was broadside to her, our speed six to eight knots, and her distance a scant one hundred yards, no opportunity could have been more favorable for the torpedo, yet it missed us, and passed astern harmless. Nor was I surprised at it, for whenever I was so fortunate as to be present at torpedo practice on any man-of-war, some reason always existed for this deadly weapon rushing at a tangent or plunging headlong into the water, possibly to turn up under the hull of your own boat. *—Harper's Weekly.*

MAN OVERBOARD.

There is no sound aboard ship so demoralizing as that of "Man overboard!" It strikes terror to the heart of the bravest, and only the best disciplined crews can withstand the panic it usually produces. Almost every ship has a particular rule of action for such occurrences. The best arrangements, however, are often inapplicable, and success depends mainly on the presence of mind of the watch, the man at the life buoy, and the normal condition of the boats.

A cool hand will drop the life buoy, sometimes within reach of a man; a "bothered" one will either not let go at all or do so before the man has got near the stern. Of all persons aboard ship, the officer of the deck should be cool and collected.

Rear-Admiral S. B. Luce lays down the principle that the most important considerations when a man falls overboard are: First, the quickest and most effectual method of arresting the ship's progress and how to keep her as near the spot where the man fell as possible. Second, to preserve the general discipline of the ship, to maintain silence, and to enforce the most prompt obedience, without permitting foolhardy volunteering of any kind. Third, to see that the boat appointed to be employed on these occasions is placed in such a manner that she may be cast loose in a moment, and when ready for lowering, that she is properly manned and fitted, so as to be efficient in all respects when she reaches the water. Fourth, to take care in lowering the boat neither to stave or swamp her, nor to pitch the men out. And, lastly, to have a sufficient number of the sharpest sighted men in the ship stationed aloft in such a manner as to give them the best chance not only of discovering the person overboard, but of pointing him out to the men in the boat, who may not otherwise know in what direction to pull.

With steamers the difficulties to overcome in rescuing a man overboard are comparatively few, inasmuch as a steam vessel is always under control so long as her machinery is in good order. The rule is to stop as quickly as possible, lower the lee lifeboat, and pick the man up. The really fine points of seamanship come into play when sailing ships are being handled. The ordeal is a trying one for the best of officers, and the young seamen who can properly place a large sailing ship and rescue a man that has fallen overboard deserve the highest credit for seamanlike qualities.

Rear Admiral Luce, one of the best seamen in the United States Navy, and now on the retired list, had a habit while in command of the North Atlantic squadron of ordering a midshipman to relieve the officer of the deck from duty, and the instant the young man took hold of the speaking trumpet the observing officer would quickly pass a signal and in a twinkling the terrible cry of "Man overboard!" would ring through the ship. It was all done to test the young midshipman's nerve and fitness for his calling, and the Admiral's delight in catching a young officer napping was amusing. Generally, however, commanding officers refrain from allowing the cry to be sounded solely for practice purposes, inasmuch as seamen have been known to jump overboard to the rescue of their supposed unfortunate shipmate. The rule is a stringent one that no sailor shall jump overboard for rescuing purposes unless permitted by the officer of the deck, but many brave fellows do so in spite of the regulation, and no few lives have been lost in foolhardy undertakings.

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Do not hesitate to give your views—if well considered—on any subject you have had experience with. It is not at all necessary that they should agree with ours, or with anyone's for that matter. We publish all sensible disquisitions which show an acquaintance with the topic discussed, and are never better pleased than when we receive articles in an original line of thought.

COAL.

The composition of coal varies. In anthracites, the most important element being carbon, it may be found as high as 90 per cent. of the mass. In bituminous coals the carbon may be from 50 to 55 per cent. But the two grades of coal have their respective uses. The anthracite, containing less volatile matter than the bituminous, has a special value for its heating qualities, while in bituminous coal it is the volatile matter, to serve for the production of gas, which is most in demand. The difference between anthracite with 3.1 per cent. of volatile matter and bituminous with 37.5 per cent. is at once appreciable. There is a transition in the condition of coal, the changes being gradual. First we have hard, dry anthracites; then semi-anthracites, semi-bituminous, and finally the bituminous coals. This question arises: Has there been any difference in the natural production of these grades of coal? The supposition is that all coal was at first bituminous and that then some of it under slow and tremendous pressure was converted into hard or anthracite coal. Theorizing further on this subject, it becomes possible to give reasons for the production of the fluid and gaseous hydrocarbons. Bituminous coal, as first formed, containing such a large proportion of volatile matter, this volatile matter might have been driven by the incalculable forces of compression out of the soft coal, condensed into mineral oils or still preserved as gases in vast internal reservoirs.

Coal is much more evenly distributed over the world than is generally imagined, and every day new discoveries are being made. Our oldest coal workings were those in Virginia, known as the Richmond or Chesterfield beds, and the date some time about the middle of the last century. It seems probable that English engineering officers, under Braddock, found coal in Pennsylvania. On the Susquehanna, coal was first systematically dug and sold, and found its way to distribution by means of arks.

How to use bituminous coal was at once understood. Readily ignited, it required no special methods. It was coal, like that in use in England, or "sea coal." It was a different matter with anthracite or stone coal. The coal coming from the Wyoming Valley was sent to England to be tested, and the answer was that it was useless. It is probable that how to utilize hard coal was not well known until the year 1810. For making iron, it did not serve its purpose before 1814, when a wire mill near the falls of the Schuylkill used it for the first time.—*Greene's Coal and Coal Mines.*

◆

Night work is hard work, and the *American Miller* discourses wisely upon it. He says: The trouble is that those who work at night are apt to burn the candle at both ends and not get sufficient rest, since their sleeping hours are when everything invites to activity. If sufficient rest is obtained, there is only one respect in which night work is more unhealthy than day work, aside from the unpleasantness of it, and that is in the nervous strain. Constant attention on running machinery produces a nervous strain that only those who have experienced it can understand. At night this tension is greater because there is nothing to divert the mind, which always seems more concentrated and receptive at night than during the hours of sunlight. Few would prefer a night watch to one in the daytime; but as some must perform work which is done at night, it is well to understand that the supposed unhealthy features of night work are largely under the control of the operative.

[Not on board ship, however.—Eds. Engineer.]

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Anyone who has gained great fame and is large in the public eye will have respectful and admiring listeners and readers when he talks or writes, whether he knows anything of the subject he discusses or not.

ELECTRICAL GOVERNORS.

Under the ordinary method of controlling electrical systems the engineer has to stand by to manipulate what is called a resistance box whenever the load at the dynamo is suddenly increased or diminished by adding to or cutting off the number of lamps. If this box is attended to instantly, matters are all right. But in a warship in time of battle it might very easily happen that an unlucky shot from the enemy would not only cut off all but a few of the lamps, but also kill the engineer whose duty it was to handle the resistance box. Or the lamps might be cut off and the engineer be too badly frightened to do the right thing. In a moment the remaining lamps on the ship would be destroyed and the dynamo as well. The magazine would be in utter darkness, and fatal confusion would prevail. The one thing for which naval men have looked was a governor for the dynamo. When it was found it was just an extra coil of wire placed on the dynamo, this coil being made of much larger wire than is used on the horseshoe magnet. It is not easy to explain the action of the extra coil of wire, but it receives the current, and serves it as a governor serves a throttle on a steam pipe of an engine. If there is a call for an increase service, the series coil, as it is called, provides it. If every lamp but one of a 500-lamp circuit be cut off at one stroke, that one lamp burns on, unaffected to any appreciable extent. There is another feature of this governor that makes it valuable to a warship whose coal space is limited. When the lamps are cut off the power of the dynamo and the consequent consumption of coal are not wasted in forcing the current through a resistance box. The reduction in the power used is almost in proportion to the load removed or the number of lamps cut off. If five hundred lamps, for instance, require fifty h. p., the power required when four hundred and fifty lamps were cut off would be, say seven h. p., which means a saving of the coal required for the forty-three h.p. dispensed with.

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Here is an occurrence which is so common in this city that it excites no more notice than a paragraph like that subjoined from a daily paper:

> "Recently a Third avenue motor blew out its cylinder head just after leaving the Chatham Square station. The flying iron demolished the plate glass window of 13 New Bowery. Fortunately no one was in the way of the missile at the time.
>
> The piece of the cylinder head which went through the window was of triangular shape, about half an inch thick, and weighs five pounds. The window, which is valued at $150, is insured with the Metropolitan Plate Glass Insurance Company, who will replace it. Col. Hain will send a man to inspect the damage."

Sending a man "to inspect the damage" seems rather useless in view of the facts. Since locomotive cylinder heads are always liable to blow out it would seem cheaper for the company to put in wrought-iron heads, which would not go to pieces, or put a guard or shield over the present ones in such a way that the fragments would be deflected into a strong box on the engine instead of into plate glass windows, or, haply, some unfortunate person's head.

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Take a polished metal surface of two feet or more, with a straight edge; a large handsaw will answer the purpose. Take a windy day for the experiment, whether hot or cold, clear or cloudy; only let it not be in murky, rainy weather. Hold your metallic surface at right angles to the direction of the wind, i.e., if the wind is north hold your surface east and west, but instead of holding it vertical incline it about 42 degrees to the horizon, so that the wind striking glances and flows over the edge, as the water flows over a dam. Now sight carefully along the edge some minutes at a sharply defined object, and you wiil see the wind pouring over the edge in graceful curves. Make your observations carefully and you will hardly ever fail in the experiment; the results are even better if the sun is obscured.—*Unknown Philosopher.*

NEW TEXTILE FIBER.

Wonderful possibilities of the vegetable okra have been discovered by W. E. Sudlow, an English engineer, now of Columbia, S. C. He has had large experience with textiles. For two years he has been looking into the okra fiber question, and reached the conclusion that it can be cheaply produced, and that the okra stalk is essentially different from the jute, cotton, and ramie in this that the wood surrounds the fiber, while in the others it is mixed with it, and this is the key to the problem of cheap production. His experiments last summer and fall prove that the okra fiber and wood are naturally separated. The mixing of the fiber with the wood of jute, ramie, and cotton makes it necessary to employ manual labor chiefly to decorticate, and this is so costly that only in India and China, where labor is excessively cheap, is it possible to produce the fiber at low prices.

Okra, on the contrary, can be separated by machinery. Mr. Sudlow says that he can make a machine which will not cost more than an ordinary cotton gin, which can be employed as gins are employed on each large farm or in each neighborhood, and that by its use planters can turn out fiber and sell it as they do cotton—for so much a pound. Into this machine the okra stalks will be fed butts forward, and it will cut the wood from the fiber. The gluten will be removed from the fiber by a simple process, and the fiber is ready.

Some beautiful samples have been exhibited. The fiber is long, exceedingly strong, between straw color and white, and with a silken gloss. The okra plant grows in this State almost without cultivation to perfection. The fiber can be subdivided so that cloth as well as rope and bagging can be made from it. It promises to become an important industry and to surpass either cotton, jute, or pine straw as a bagging for cotton.

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One hundred millions of dollars of English capital have been invested in various American industrial enterprises within the last twelve months, and the prospect is that in the present year a much greater amount will follow. No disturbance of our financial or commercial system has ensued, and it is probable that in our present condition of growth and activity we can regard with equanimity the invasion of almost any conceivable quantity of European money.

Of the immense amount which sought investment here in 1889, a very large part appears to have been new money. That is to say, a scrutiny of the market for our railroad and Government securities does not show that the demand for industrial stocks has been a simple substitution of that class of security for the other. The immense bulk of foreign investment in our railroads remains practically unchanged, as is clearly disclosed in the recent reorganization of our great railroad corporations.

We do not see any danger, either in the present or in the future, for our industries; and we see very little danger in it for the English investor. Money is plentiful throughout the whole country, more plentiful than ever before in our history, and certainly more active. It is not local, but universal, this development of our industrial growth, and the English investor can derive from it a very satisfactory assurance of the safety and productivity of his capital.—*N. Y. Sun.*

◆

A steamer loaded with sugar had to burn 24 mats of it to reach the port of Philadelphia. She had previously burned all the loose stuff that could be got at. Sugar makes a good fuel, but at something like $100 a ton it costs too much to run steamships with very long.

◆

Horatio Allen was the originator of the overhung cylinder now so generally used on stationary engines. At all events none were in general use prior to 1860, when they were first built at the old Novelty Iron Works, N.Y.

AN INGENIOUS AMERICAN CLOCK.

In an old barn at Pittston, Pa., is in operation a clock, standing 12 feet high, 7 feet wide, and 3 feet deep.

The clock as it now stands is composed of two parts, on the lower one of which there are eight dials. No. 1 shows the ordinary clock dial, with minute and second hand; No. 2, a series of figures which tell the number of minutes; No. 3, the number of hours which have passed since the begining of the year; No. 4, the number of days which have passed in the year, and by an ingenious device, one figure is skipped by the dial in leap year. No. 5 is a split-second dial, and which, by the simple touching of a spring is made to stop at the quarter second. No. 6 tells the time of meridian, forenoon or afternoon, and also the hour by the twenty-four-hour system. No. 7 tells the number of days which have passed in the month, and No. 8 the day of the week.

But it is in the upper section of this clock that the genius of the maker is displayed at its best. On the base of this part is a miniature railway situated, on the edge of a beautiful city. The scenery is unusually natural, and as it shifts to evening hundreds of stars are suddenly made to twinkle, first faintly and then in full distinctness, in the disk representing the heavens. The mechanism which operates the stars is so arranged that it takes two hours for the wires holding them to descend from the recesses of the cabinet to a point over the city. A prominent feature is a small railway station. The tracks of the railway emerge from a tunnel at the right hand corner; with the bell tolling and the whistle tooting, the train pulls up at the station. Here, by automatic arrangement, a stop of five minutes is made, during which the door of the waiting room opens, and three passengers make their appearance. The station agent also appears, the flagman throws a switch, gives the signal, and the train then resumes its journey. During its absence a second engine makes its appearance, coming to the front from a side switch, which is always securely locked upon the approach of the first train. The realism of the scene is heightened by the presence on the reverse side of the station of a vigilant gatekeeper, who lowers the gates and waves the danger signal at the approach of trains. There is also in operation an electric street car, which passes the station in time to receive passengers from the train.

In the center of the clock, just over the miniature representation of the city, there is an alcove, in which appears, at intervals of five minutes, one of a dozen figures which represent twelve stages in the life of man, from the toddler learning how to walk to the grandsire. As the twelfth figure makes its appearance at the close of each hour, Time with an hourglass in his hand, appears at an opening in the top of the cabinet and strikes the hour of the day on a silver bell. On two small dials, located on either side, are two human hands, the one pointing to the season of the year and the other to the week of the year.

The inventor and originator of this ingenious contrivance is a young mechanic named Thomas Fitzsimmons. Thomas is only 23 years of age, has never had any education beyond that acquired in the common schools, and was never identified with a watch or clock making establishment. His faculty of inventing things is purely inherent, and since he was old enough to be about his spare time has always been devoted to mechanical experimenting. The clock has enlisted his attention for four years, and now lacks but the painting and decorating to make it fit for public exhibition.

◆

Invitations to balls come thick and fast in these days. The latest is that of the Marine Engineers' Association of Chicago, who intend to celebrate in Brand's Hall, in that city, January 29. Dearly beloved brethren, the spirit is willing but the flesh is weak.

TRADE NOTES.

THE '*Venezuela*' is a new vessel to run between this city and Laguayra. She was built by Cramp & Sons, and launched Oct. 19. She is 325 feet long, 40 feet beam, and 28 feet deep. She measures 2,800 tons. She is expected to develop 2,000 horse power, and make, on an expeuditure of 32 tons a day, an average of 14 knots an hour.

* * *

A CRUSADE has begun in England to put a stop to the system of foisting sham electrical appliances upon the public. A vender of "electropathic belts," which were said to cure sciatica and innumerable other ailments, has been brought into court and punished for obtaining money under false pretences. The crusaders can find a good opening in this country.

* * *

THE Mallory Steamship Line is running a new vessel, the '*Leona*,' with triple expansion engines. When running eleven knots an hour she is said to be a most economical coal consumer, but add a couple of knots to this and the coal consumption increases astonishingly.—*Times*.

Yes, sir, and without the triple cylinder engines it would be still more astonishing.

* * *

LOCOMOTIVE building has not been as large in 1889 as it was in the year preceding. The falling off has not been serious. In 1888, 2,180 locomotives were built by 17 firms. In 1889, 1,860 were built by 16 firms. The product of the firms not reporting would probably not raise the output to 2,000. Thirteen of the firms reported in both years. The average yearly product of 19 firms for the eight years 1880–'88 was 1,645 locomotives.

* * *

ARRANGEMENTS have been made to start a new water company in Elizabeth, N. J., in opposition to the present one. The new company is composed of New York and Elizabeth capitalists, the former furnishing the bulk of the money. Among others here who are said to be interested in the venture are Sheriff Glasby and ex-Congressman Clark. It is proposed to supply the water by means of artesian wells, which will be sunk at South Elizabeth. All the capital required has already been subscribed, and the syndicate will begin operations in the spring.

* * *

THE latest direction in which British capitalists have looked for investments in this country is toward the big cotton mills. Negotiations are well advanced for the purchase of three of the greatest mills in America at a cost of $20,000,000. Two of these mills are in New England and the third is in the Middle States. Optious on these properties were obtained some time ago, and an investigation by experts of their condition is now in progress. The mills referred to make ouly standard cotton goods and no fancy products.

* * *

OFEICERS of the navy and revenue marine are laboring assiduously to combine the two services. Secretary Tracy has replied to Mr. Barker, Chairman of the House Committee on Commerce, recommending the passage of the Lodge bill without amendment. The Lodge bill is the same as the Chandler bill introduced in the Senate, referred to the Senate Naval Committee, and reported on favorably. The Chamber of Commerce and Board of Trade of New Orleans have now passed resolutions favoring the proposed transfer. Both bodies have asked their representatives in Congress to secure if possible the passage of the proposed measure.

* * *

CHARLES F. ELMES, Chicago, is building for the Goodrich Transportation Company a fore and aft compound engine 28 and 50 by 36 for their steamer which is being built by Burger & Burger, at Manitowoc. The engine is of the same pattern as the one built by Mr. Elmes for the Goodrich company's steamer '*City of Racine*,' which proved a great success last season. The engine will be shipped to Manitowoc this month. He is also building a triple engine, three 8 by 8 cylinders, crank set at 120 degrees for a steam yacht building at Lake Geneva for Geo. L. Dunlap, of Chicago. Her dimensious will be 60 feet over all, 10 feet beam, 4 feet draught and she will be propelled by a Delamater wheel 44 inches diameter which will make 400 revolutions per minute.

* * *

The only ship railway in North America is rapidly approaching completion. It is designed to convey vessels over the Isthmus of Chignecto, which joins Nova Scotia and New Brunswick, a distance of seventeen miles. The roadbed is ballasted and ready for track laying, and the docks at either end are in process of construction. The steel for the track weighs 110 pounds to the yard. There will be a double track, upon which the cradle containing the vessel under transport will be placed. The locomotives, two of which will be used in drawing the vessel across the Isthmus, are built on the same principle as ordinary engines, but of much greater weight and power. The vessels to be transported will be hoisted by hydraulic power from the basin to the track, and it is estimated that a ship of ordinary capacity will be taken from the Bay of Fundy and placed in the Gulf of St. Lawrence in two and a half hours, though a speed of ten miles an hour is obtainable. The tariff for lifting and hauling vessels over the railway will be 50 cents per ton for cargo and 25 cents per ton for hull, so that a vessel of 1,000 tons would pay $750 for transportation. The permanent success of the scheme is looked upon as highly problematic, for the class of schooners engaged in trade at present are totally unable to bear any such charges.

* * *

The new process of cutting veneers is, in outline, as follows: The log is first opened, as it is technically called; that is, it is cut longitudinally through the center. The halves are then steamed, and are ready for the new machine. The machine makes a diagonal cut. The log is moved up and dowu in a diagonal plane, and the knife is adjusted underneath to the required thickness of veneer, a veneer being taken off each time the log descends. By this process a flat-cut veneer is produced, which is in every way preferable to one cut by the rotary process; for, by this latter method, cutting around the log, the pressure of the cut is always towards the center, which necessarily leaves the bottom surface of the veneer slightly smaller than the top, so that when the veneer is laid on to a flat surface it is likely to open. In the flat-cut veneer, on the other hand, the grain is not disturbed, the upper and under surfaces are equal in area, and all danger of splitting is avoided. By the new process a veneer can be cut 12 feet 6 inches long up to 26 inches wide. By no other process can so large a veneer be cut. The veneers after being cut are taken to a drying room and stood on edge between uprights until thoroughly seasoned. When this process is completed, the veneers are replaced in the exact outline of the original log so skillfully that one could hardly detect that the log had ever been "opened."

* * *

WHAT seems to be wanted is a scientific, uniform system of bookkeeping for railroads by which expenditures shall be classified on principle, and not arbitrarily, at the whim of one or two men; and construction and expense accounts so kept that the actual earnings of the property applicable to dividends may appear in them correctly. In early clerking days we had, for example, in regard to shipping repairs, a rule, "one-third new for old," that is, one-third of the value of new construction was deducted to allow for the value of the old which it replaced. It seems that a similar rule, the exact terms of which could be fixed by expert railroad men, might be devised for railroad work, and new cars, locomotives, bridges, station houses, ties and rails estimated according to it. No one pretends that new mileage and new station houses, or additional cars and locomotives, beyond those needed to replace old ones destroyed, are properly chargeable as running expenses, and yet, on the books of some ultra conservative companies, all such items are thus disposed of. Other companies go to the other extreme, and call every new car and every new locomotive an addition to capital, regardless of the discarded old ones, whose place the new barely fill. When this point is settled, the question of how much dividend shall be paid, or whether contingent interest on income bonds has been earned, will be easily settled also.—*N. Y. Sun*.

◆

WHAT eats up the high rents in the big flat houses is the hiring of servants and the keeping of the flats in repair. The owner of a big flat house cannot well put the repairs on the tenants in the way the owners of private houses do. Even if a clause were inserted in each lease of a big flat house that the tenants would have to pay for the repairs, the owner would have the care of all the halls, the elevators, the cellars, the attics, and the heating and plumbing, anyhow. The tenant would not repair anything outside of his own flat. It would be hard to make him paint the woodwork around the windows, even if each tenant might not fancy a different color or shade for his own. The tenant could not be forced to keep the front of the house in repair. A big flat house requires the services of plumber, carpenter, and painters constantly. It makes a difference of half of one per cent. in the return on the cost of a flat house whether an elevator is run or not. Flat house elevators do not last the way business office elevators do, and they do not have the same kind of use. Elevators require the employment of one or two boys or men to look after each one. There must be an engineer and a fireman, or two engineers and two firemen. Then there are the constant repairs to the elevators and elevator shafts, added to which is the interest on the greater cost of constructing a building with elevators. Then a big flat house has more servants in proportion than a small flat house. The servants wear liveries. The liveries cost money, and it costs money to pay the servants who wear the liveries. There is a man at each entrance day and night. This is not necessary in a small flat house, where the doors are always kept closed, and where the people who live there carry latch keys instead of pushing an electric button and waiting until the portals are thrown open by the liveried minion. Every big flat house has a superintendent, who gets from $1,500 to $5,000 a year. Smaller flats are looked after by agents.

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And then he made a big machine for flying through the sky,
But there was a slight obstruction in the piston rod or groove,
And the only trouble with it was he couldn't make it fly.

And he made marine toboggans for sliding on the sea,
A very pretty compromise of bicycle and boat.
And on the second trial trip, he said 'twas his idee,
The thing would slide tremendously, if he could make it float.

And he made a panacea that would cure every ill,
The long-sought life elixir, to the world so long denied;
He took the medicine himself, a large, green looking pill,
And twenty minutes later he laid him down and died.

—*S. W. Foss, in Yankee Blade.*

◆

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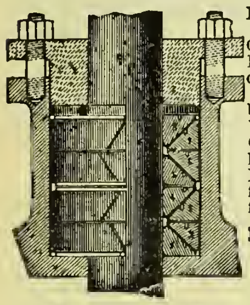

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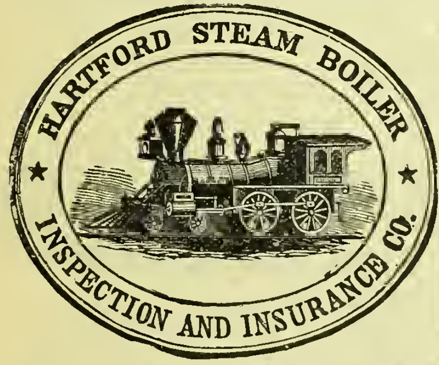

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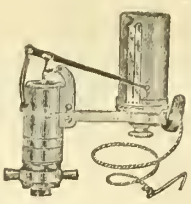

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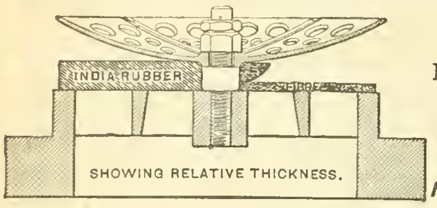

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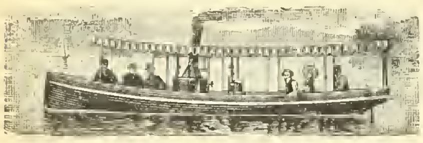

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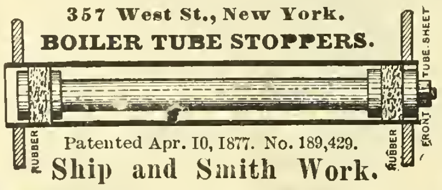

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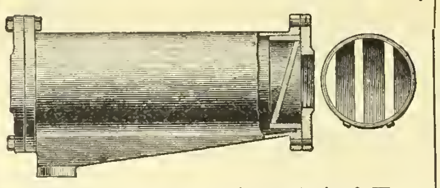

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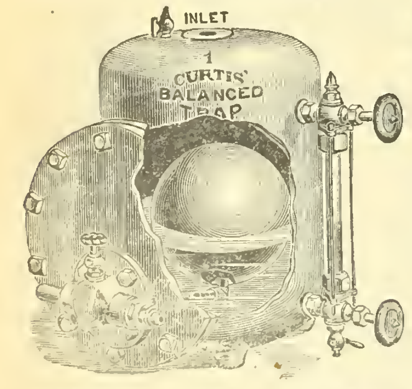

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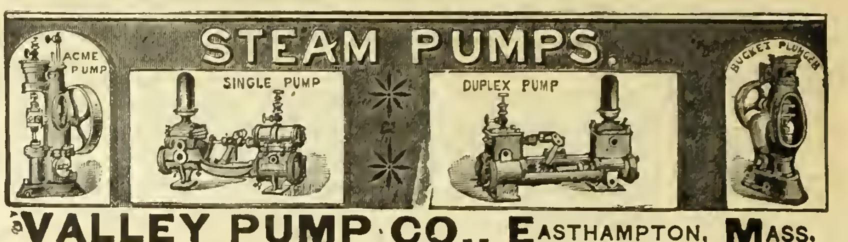

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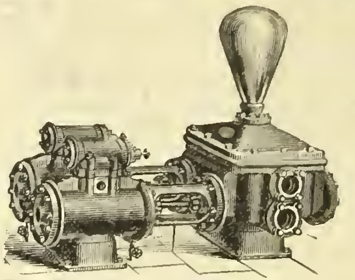

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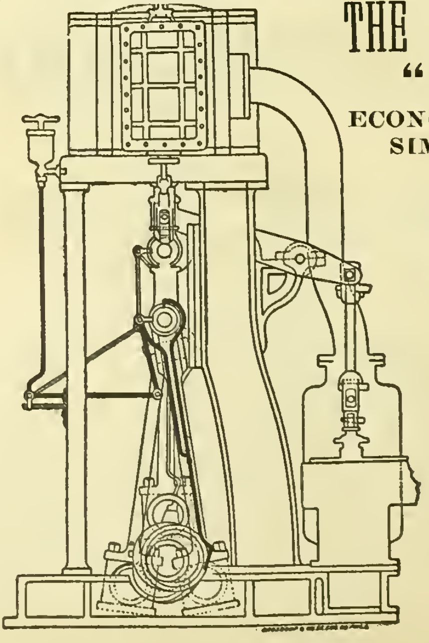

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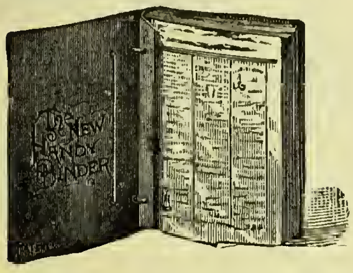

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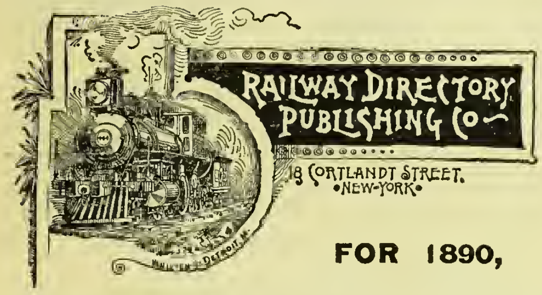
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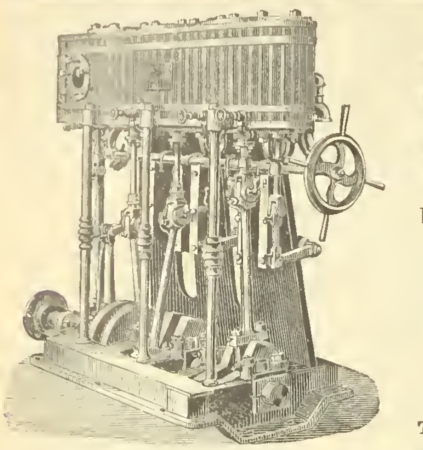

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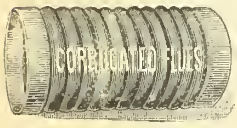

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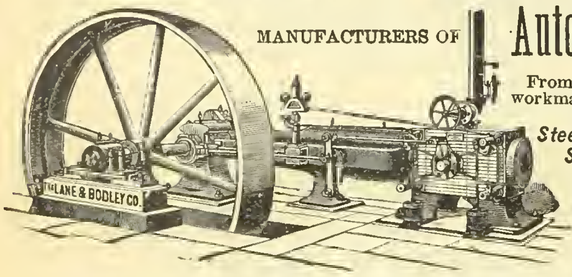
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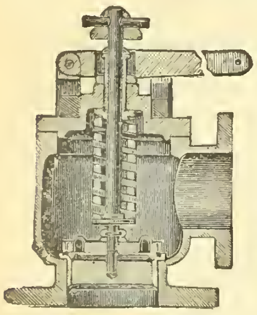

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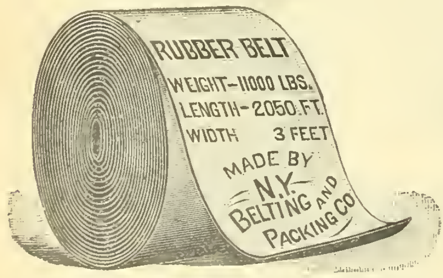

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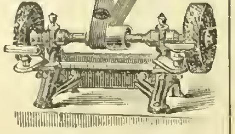

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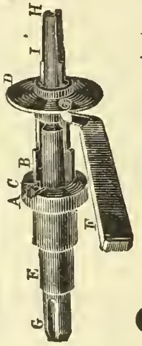

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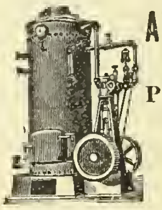

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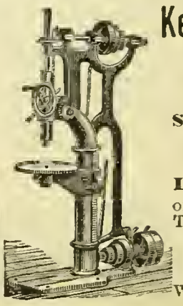

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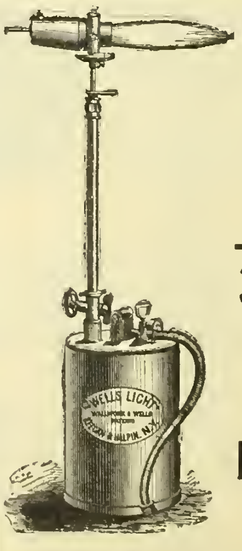

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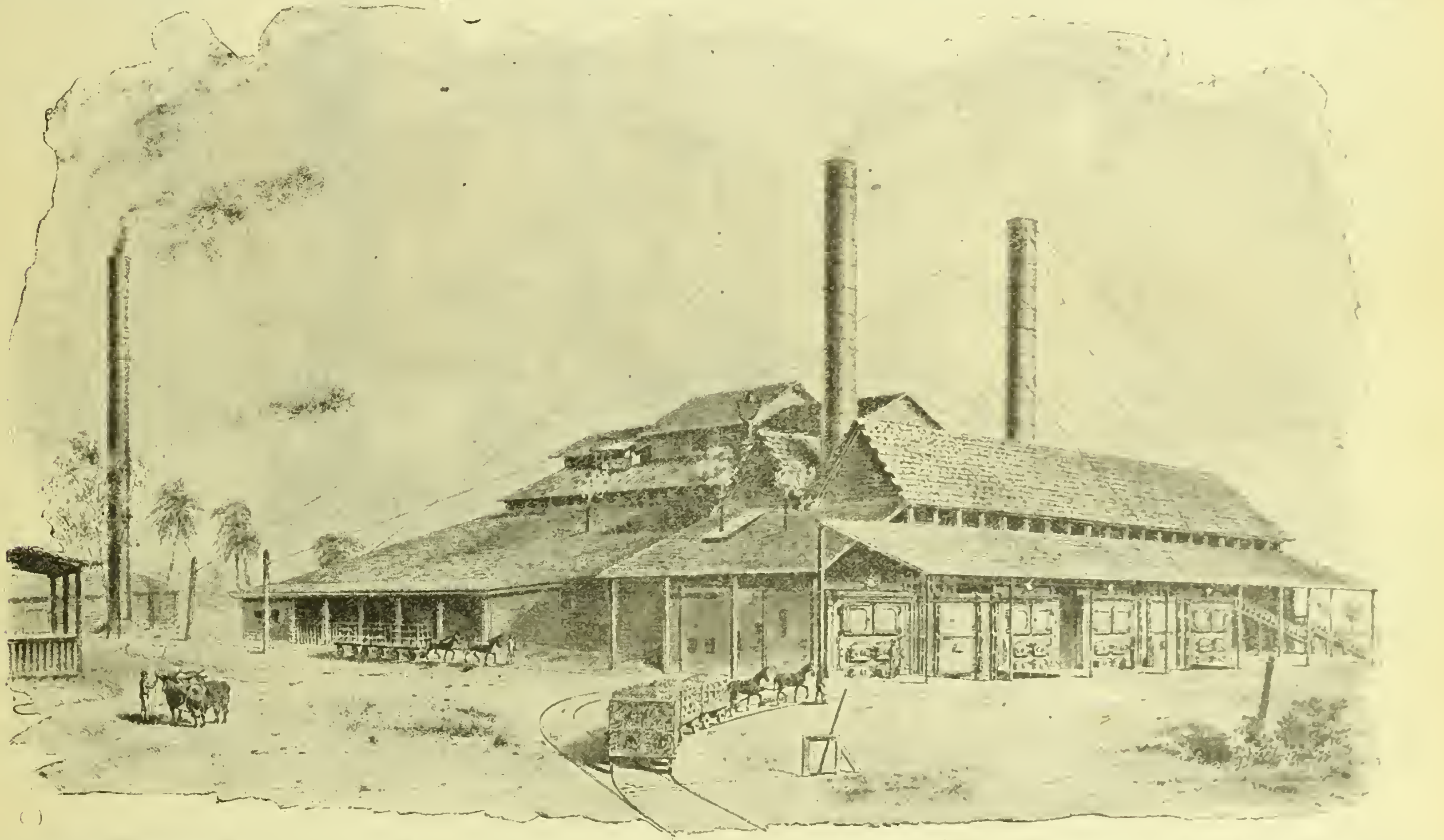
A VERY important and interesting improvement in furnaces for burning green bagasse has lately been introduced, and is here shown as applied to the Babcock & Wilcox water-tube boiler. Bagasse, as many of our readers know, is the refuse left after grinding sugar cane; it has hitherto been useless for fuel as it came from the rolls. Although many attempts have been made to burn it, we know of none which are practically successful. Bagasse contains from 25 to 40 per cent. of wood fiber and from 6 to 9 per cent. of sugar; the balance is water. As it comes from the rolls it is not combustible; when dried in the sun all the sugar is lost by fermentation. This sugar is a good steam maker, and if the bagasse can be used as it comes from the mill so much is saved. The apparatus here shown attains this result, and not only affects a saving by burning the bagasse itself, but dispenses with the labor of a very large force of men and animals which were formerly required when the bagasse was sun dried. Cook's system also secures much better combustion under the boiler itself, for a portion of the waste heat escaping from the chimney is used to heat the blast. Air at 200° has over 200 times the capacity for absorbing moisture that air at 60° has; when supplied to the furnace at 300° it will dissipate the moisture of the fuel without robbing the boilers in any respect of the heat generated from the combustible portion of the bagasse, the wood fiber and the sugar. It is thus apparent that the theory of Cook's system is correct, and it only remains to apply it mechanically. This is done as shown in the engraving, and it is only necessary for us to describe the furnace itself. This consists of an oven of brick having a smaller chamber beneath, into which the blast previously heated is introduced through numerous perforations in the walls. Openings in the walls of the oven permit the escape of the gases of combustion to the boilers. On their way to the chimney these gases pass tubular heaters, through which a fan forces the blast *en route* to the burner, thus returning a large part of the waste heat to the furnace, and securing an exceedingly high temperature therein.



The furnaces require to be cleaned once in twenty-four hours, when the refuse from 250 tons of bagasse makes about four wheelbarrow loads, in the form of a vitreous mass, evidencing the intense heat generated, which literally melts the silicious coating of the cane into slag, or crude glass. This high temperature is readily absorbed by the Babcock & Wilcox boilers, without injury to the heating surface, but it is not considered safe to apply it to other boilers having thicker heating surfaces, and less perfect circulation.

The bagasse is fed to the furnaces automatically by an arrangement of carriers which receive it from the rolls and distribute it equally to the different furnaces, where more than one is required, dumping any surplus upon cars where it is stored for use when the mill is not grinding. The number of attendants required is reduced to a minimum, every operation being automatic. At Yngenio Senado two of these burners reduce the number of men employed from two hundred and fifty to sixty, besides the saving in wood and teams, the better supply of steam, the ability to grind during rainy weather, and the total absence of risk of fires. As a rule the cost of the apparatus is repaid in the first crop.

Four of Cook's apparatus with Babcock & Wilcox boilers have now taken off four crops each in Louisiana, with no repairs or stoppages, and with perfect success in every case. Five burners in Cuba the last season worked through the entire crop—their first—without the least stoppage or trouble. No wood was required after the first starting, the spare bagasse serving to light the burner after stopping for cleaning, as well as to keep it running when the mill was not grinding. Burning green bagasse with economy and efficiency is therefore no longer a problem, but an assured success.

Cook's apparatus is the subject of numerous patents in all sugar producing countries. These patents are all owned or controled by the Babcock & Wilcox Company, New York.

• ◆ •

IN Germany a railway flagman at the crossing at a small station thought he had the grip when all the other employees of the road were getting leave of absence for the same cause, and applied to the company's doctor to be examined. The doctor could not spare the time to stop at such a small place, so he telegraphed to the flagman to be standing beside the track when the train went past, with his tongue out, and he would examine him on the fly. The flagman dutifully stood with his tongue out all the time the train was slowly passing his station, and the next day the company received from passengers a dozen complaints of the impertinent conduct of one of its employees.

BOILER MAKING. No. 32.

By John Cook.

The formula to get the per cent. of rivet to solid plate is $\frac{n.\ a.}{p.\ t.}=Z$, which means to multiply the number by the area, and divide by the sum of thickness of plate, multiplied by pitch of rivets.

Example:

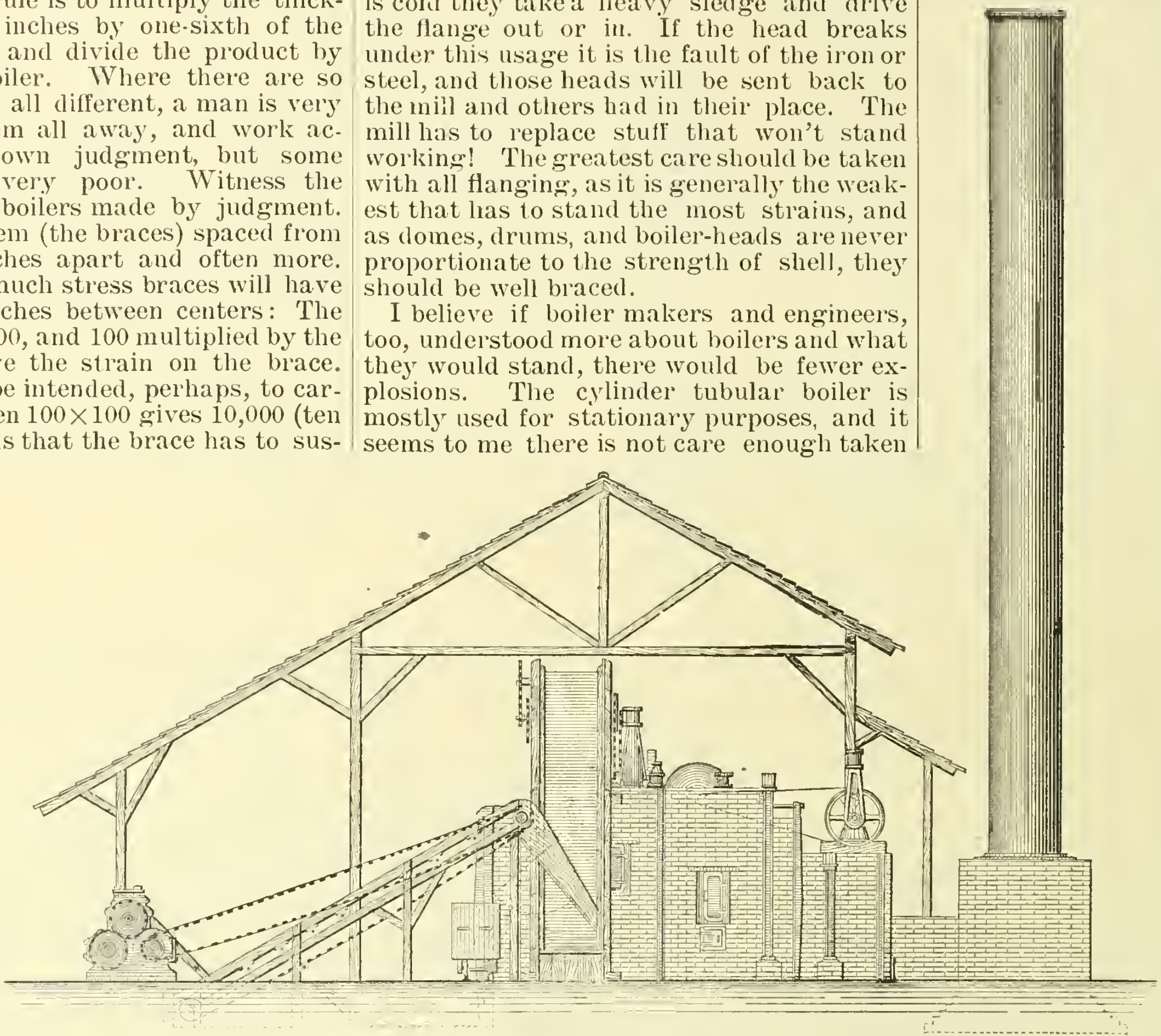
```
.3125=thickness  .306796=area of ⅝ rivet.
    2=pitch                1=number of rows of rivets.
.6250        6250)306796(49=Z per cent. compared with
                  25000                   solid plate.
                  56796
                  56250
                    546
```

These rules give a low per cent. of joint and rivet, but there is no doubt if they were followed up that they would be safe; but I am sure there are but few who think anything about rules of this description. By United States law we could get 97 lbs. pressure on same size boiler with same tensile strength (44,800). This rule is to multiply the thickness of plate in inches by one-sixth of the tensile strength, and divide the product by the radius of boiler. Where there are so many rules, and all different, a man is very apt to throw them all away, and work according to his own judgment, but some judgments are very poor. Witness the bracing in some boilers made by judgment. You will find them (the braces) spaced from ten to fifteen inches apart and often more. Let us see how much stress braces will have to bear at ten inches between centers: The square of 10 is 100, and 100 multiplied by the pressure will give the strain on the brace. The boiler will be intended, perhaps, to carry 100 lbs. Then 100×100 gives 10,000 (ten thousand) pounds that the brace has to sustain. If 150 lbs. is on the boiler, there would be 15,000 lbs. Possibly the brace will be of ¾ or ⅞ round iron. The law says that not more than 6,000 lbs. to the square inch of area of brace shall be allowed. Now the area of ¾ round iron is only .4417, or not quite half a square inch for the ¾ round brace, and but little over half a square inch for a ⅞. If this is pointed out to some men, they will "pooh-pooh" at it, and assert that the crow-feet, or angle, or tee-irons, take up some of the space. What if it does? The strain goes through the brace first and last, and if it does not hold, the crow-feet won't keep the head in. If boiler makers would adopt some one safe rule, and work by it, their boilers would be better. Supposing we take 6,000 as the standard (Wilson gives 4,000), and, as most all stationary and portable boilers are tested to 150 lbs. cold water pressure, use that pressure to work by. Now, if 1″ round iron is used for braces, we can put them 6″ apart, and be safe. The square of 6 is 36, and that multiplied by 150 gives 5,400 lbs. per square inch, and as the square of 1 inch round is .7854 we would have the brace about right—that is, with iron of good quality.

There are some who will not believe that there is any more on the braces than what the gauge shows, or that there is any more in the whole boiler. There are other times when you will see braces put close together about the center, or just above the tubes, and a space of from 9″ to 12″ between braces and flange of head. That is, I consider, robbing Peter to pay Paul. Many think if the center of pressure is secured the boiler is all right. I got taken in on that plan myself once, but only once. It was at a time when we were rushed with work, and thought I would try it for one boiler to see how it would work, but before I got the full test on I wished I had not done it. When there was only 120 lbs. on I could see the space above the braces dishing out. I did not wait to measure how much it came out, but put five more braces on each head, where, if I had had common sense, I would have saved four braces, or two on each head; but I was made to understand that there was as much pressure near the flange as there was in the middle, to the square inch. The flange certainly stiffens around the heel and a little away from it, but unless it is properly done it does not strengthen, but quite the reverse. Some flange turners may be seen knocking the flange in and out about a half dozen times before it suits them, and they only stop because it is too cold. Even when the flange is cold they take a heavy sledge and drive the flange out or in. If the head breaks under this usage it is the fault of the iron or steel, and those heads will be sent back to the mill and others had in their place. The mill has to replace stuff that won't stand working! The greatest care should be taken with all flanging, as it is generally the weakest that has to stand the most strains, and as domes, drums, and boiler-heads are never proportionate to the strength of shell, they should be well braced.

I believe if boiler makers and engineers, too, understood more about boilers and what they would stand, there would be fewer explosions. The cylinder tubular boiler is mostly used for stationary purposes, and it seems to me there is not care enough taken in bracing the heads of these boilers. For instance, a thirty-six inch cylinder tubular boiler has but two or three braces, at most, in each head, besides the tubes. Such a boiler will have thirty 3″ tubes, and the top of the top row of tubes will be about 3½″ above the center. This leaves very nearly three hundred and fifty-eight square inches to be supported by braces. To find out how many braces there are wanted we must multiply the area by the pressure the boiler is to carry. We will call the area 357.″97 and the pressure 100 lbs, 35,797 lbs. on the head, which, divided by 6,000, the load one brace one inch area should carry, gives the number of braces. The unsupported area is very nearly 36,000 lbs., so there should be six braces. By having only three braces, as usual, each brace has to carry nearly double what it should with safety, even if the welds are as strong as a solid bar.

(*To be continued.*)



SIDE VIEW OF COOK'S AUTOMATIC APPARATUS FOR BURNING GREEN BAGASSE WITH BABCOCK & WILCOX BOILERS, AT YNGENIO SENADO, CUBA.

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In cases of poisoning by acids, carbolic or other, an antidote ready to hand is very strong soap suds taken internally.

◆

John Ericsson was over 60 before he had much of an income.

THE LENGTH OF BOILER TUBES.

The Paris, Lyons and Mediterranean Railroad of France has been making some experiments on the comparative value of short and long tubes in the locomotive boiler. These experiments were made in order to determine the most satisfactory length to use with compound locomotives. Some of the conclusions are interesting. With an equal amount of total work performed, it was found that the quantity of water vaporized per pound of coal was always decreased when the length of the tubes decreased, but that the diminution inefficiency was small when the length was decreased from 23 ft. to 19½ ft., and even to 16½ ft. the decrease in economy was very slight. From 16½ ft. to 14¾ ft. the reduction in economy is much greater, and from 14¾ ft. to 13 ft. it is considerable. After this point is reached a further reduction below 13 ft. in length reduces the economy regularly; that is, almost in proportion to the deduction of total heating surface.

It was further found that if it was desirable to consider, instead of the amount of water vaporized per pound of coal, the total amount vaporized in a boiler in a given time, the change in tube lengths produced a different result. When the length of tube was decreased below 23 feet the total quantity vaporized in a given time was considerably increased, and kept increasing until it was at a maximum between 14¾ feet and 13 feet; but after that a further reduction decreased the amount evaporated. When the tubes experimented with were about 9.8 feet in length the total evaporation in a given time was reduced to be equal to that when they were 16½ feet in length. As a result of these experiments the road has adopted standards for lengths of tubes varying from 13 feet to 14¾ feet, the average approaching nearer to 14¾ feet. With boilers having tubes of these lengths there is found a total evaporation in a given time about 5 per cent. greater than with boilers having tubes 16½ feet in length, but to the contrary there is a loss in the water evaporated per pound of coal varying from 2½ to 5 per cent.

◆

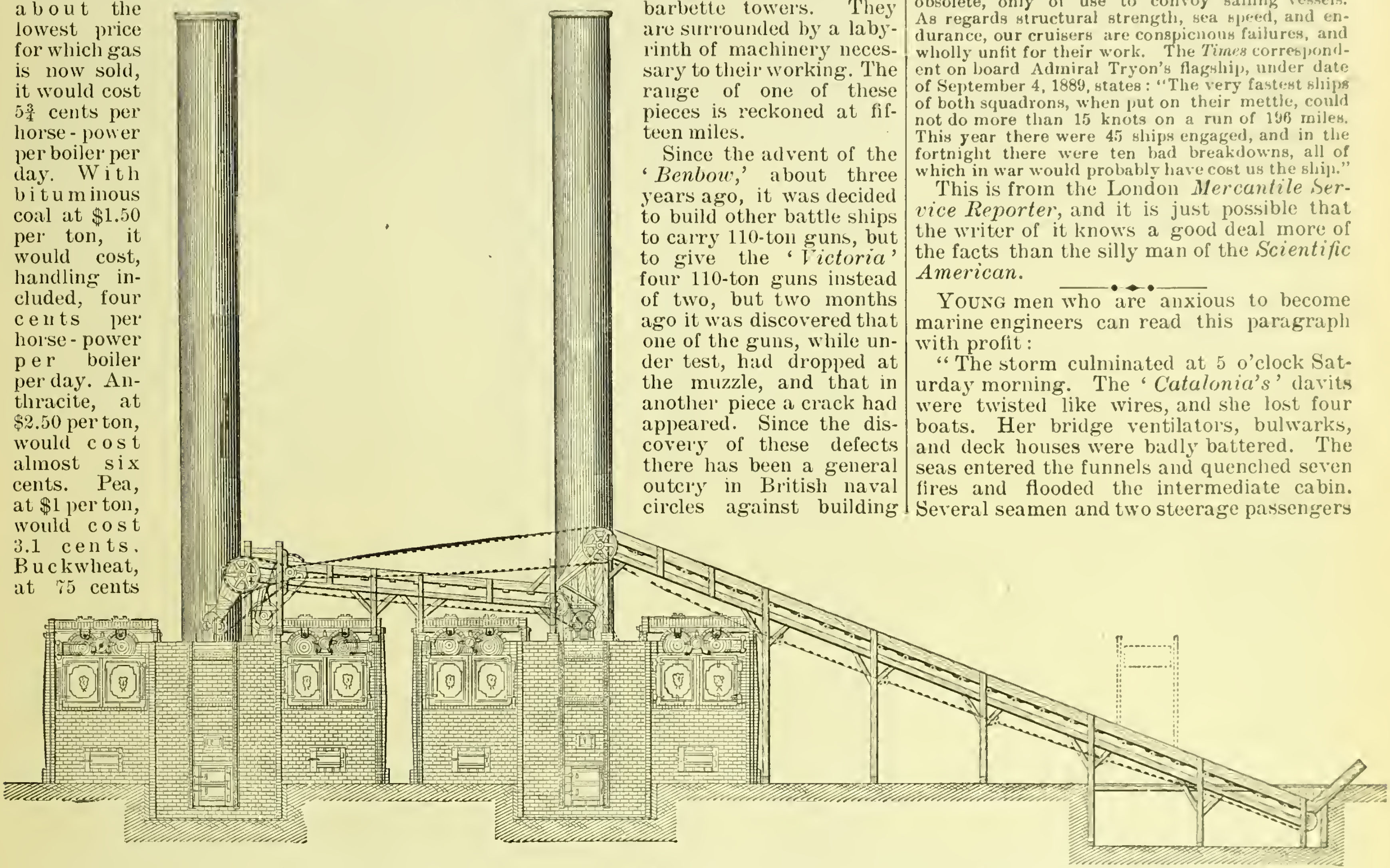
It is curious to note that engineers revert to types of engines supposed to be obsolete. Messrs. Laird, of Birkenhead, are now carrying out alterations in the '*Violet*' and '*Lily*.' Hitherto these boats have been driven by oscillating engines working at about 40 lbs. They are now being fitted with triple-expansion engines of three cylinders with a 6 ft. 6 in. stroke, and diameters about 45 in., 60 in., and 106 in., will stand directly under the crank shaft. The engines will be of the steeple type, invented years ago by David Napier, and modified by Todd and Macgregor. The '*Lily*' and '*Violet*' will carry pressures of 150 lbs., and it is expected that they will attain one knot an hour more with the new engines.

◆

When a patent vender tells you he can sell your invention, just ask him to show a list of the patents he has sold, with proof thereof. In most cases that is the last that will be heard from the patent vender.

CHEAP FUEL.

THE report of the Scranton Board of Trade gives the following in reference to the use of culm: It is not expensive to use. Any grate that will admit of a steam draught will answer, and these can be placed at small cost. A company in Scranton uses boilers of 365 horse-power, and consumes 7 tons of culm a day, at 10 cents a ton royalty. The plant is erected on the side of a culm pile, and the material shoveled directly into the fire. To handle this culm and wheel away the ashes requires the services of two firemen at $50 and $45 a month, respectively, and one ash man at $35 a month. This gives 1.56 cents per horse-power per boiler per day. To do the same work with natural gas, with 30,000 cubic feet to the ton, as given by such high authorities as Leslie, Ashburner, Ford, and others, at ten cents a thousand feet, which is about the lowest price for which gas is now sold, it would cost 5⅝ cents per horse-power per boiler per day. With bituminous coal at $1.50 per ton, it would cost, handling included, four cents per horse-power per boiler per day. Anthracite, at $2.50 per ton, would cost almost six cents. Pea, at $1 per ton, would cost 3.1 cents. Buckwheat, at 75 cents per ton, would cost $2.62. Allowing for the difference in amounts used to produce the same steam, would make some difference in the amount per horse-power, but would not much affect the general result. Taken generally, it may be safely stated that fuel per horse-power per boiler costs per day as follows: Anthracite coal, prepared sizes, from 5 to 8 cents. Bituminous coal, from 4 to 6 cents. Natural gas, from 3 to 5 cents. Culm, from ½ to 2 cents. Another Scranton concern, however, is doing even better than the above. Owning its own culm pile, it simply runs the coal into the fires by automatic slides, and its fuel costs only the price of handling, or one-half of one cent per horse-power per boiler per day.



FRONT VIEW OF COOK'S AUTOMATIC APPARATUS FOR BURNING GREEN BAGASSE, AND FOUR BABCOCK & WILCOX BOILERS, AT YNGENIO LOQUEITIO, CUBA.

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PERHAPS this is not much of a paragraph, but it is worth a few lines. A journal which gives premiums to subscribers as an inducement to read the paper, or take it, at all events, has just published its list of awards. It received, it seems, as the proceeds of 8 clubs, 734 subscribers at one dollar each. It paid in premiums ("valued at") for them $937. This is a commentary on something; just what we don't know. Probably, the worthlessness of things given away.

GREAT GUNS DANGEROUS.

RECENTLY while firing the 110-ton guns aboard the English iron-clad '*Benbow*,' defects were developed that make it dangerous to use them further.

Of the seven great 110-ton guns now in existence, four are broken down, although they have never been subjected to the strain of half an hour's firing.

The 110-ton guns aboard the '*Benbow*' are muzzle-loading Armstrong's of 16-inch caliber. They are the heaviest guns carried by any warship afloat. The weight of the projectiles for these guns is 1,800 pounds, and that of the charge of powder 900 pounds. The guns were made at the works of Lord Armstrong, and in general appearance resemble the ordinary Armstrong of 25 tons weight, differing only in size. The '*Benbow*' carries two of these monster guns mounted in her barbette towers. They are surrounded by a labyrinth of machinery necessary to their working. The range of one of these pieces is reckoned at fifteen miles.

Since the advent of the '*Benbow*,' about three years ago, it was decided to build other battle ships to carry 110-ton guns, but to give the '*Victoria*' four 110-ton guns instead of two, but two months ago it was discovered that one of the guns, while under test, had dropped at the muzzle, and that in another piece a crack had appeared. Since the discovery of these defects there has been a general outcry in British naval circles against building any more such expensive weapons, their cost being not much under $150,000 for each gun.

So rapid is disintegration and erosion in these great guns, that the life of one ceases after the firing of seventy-five shots. Again, it is said, they are so unwieldy that it is impossible to load and fire with rapidity. An enemy choosing to close action might prevent one of the 110-ton guns firing more than a couple of rounds by rapidly crossing the dangerous space before a third shot could be made. Of the 110-ton guns in existence, three are built for the '*Victoria*,' two for the '*Benbow*,' and two for the '*Sans Pareil*.' The building of ordnance of this magnitude has been to satisfy a British craze to outstrip all nations in the production of powerful weapons of war.

◆

A SUBSCRIBER in Butte, Mont., says the temperature goes down to 25° below zero in his location, and he adds that it is pretty cold weather to operate engines and boilers in, with only one thickness of boards to the shed which covers them. It seems to us that if the plant is at all permanent it would pay to house it better. Two thicknesses of boards with a dead air space between, of six inches, would afford greater protection.

A FRIENDLY TIP.

THERE is a writer on the *Scientific American* who is never tired of complaining of the inefficiency of the American navy, and never tired of shouting for the English navy. We are sick of this man, because he really knows nothing whatever of either navy, except what he reads in the daily papers. We wish he would read this extract and ponder over it, and keep still hereafter:

> "There is an entire consensus of opinion, among those competent to judge, that in the event of war our navy would not be equal to its duties. We have not at this moment a man-of-war that can cross the Atlantic at 15 knots, though there are both British and foreign mail steamers doing it at speeds up to 20 knots. Drawing the line at 1,000 tons B. M., we have of ships, good, bad, and indifferent, to protect our commerce, 68, or, allowing for those under repairs, a very favorable estimate would be 60 vessels, of which one-half are modern, and of good speed upon paper; the other half all slow and many obsolete, only of use to convoy sailing vessels. As regards structural strength, sea speed, and endurance, our cruisers are conspicuous failures, and wholly unfit for their work. The *Times* correspondent on board Admiral Tryon's flagship, under date of September 4, 1889, states: "The very fastest ships of both squadrons, when put on their mettle, could not do more than 15 knots on a run of 196 miles. This year there were 45 ships engaged, and in the fortnight there were ten bad breakdowns, all of which in war would probably have cost us the ship."

This is from the London *Mercantile Service Reporter*, and it is just possible that the writer of it knows a good deal more of the facts than the silly man of the *Scientific American*.

◆

YOUNG men who are anxious to become marine engineers can read this paragraph with profit:

"The storm culminated at 5 o'clock Saturday morning. The '*Catalonia's*' davits were twisted like wires, and she lost four boats. Her bridge ventilators, bulwarks, and deck houses were badly battered. The seas entered the funnels and quenched seven fires and flooded the intermediate cabin. Several seamen and two steerage passengers were injured. A steam pipe burst, the explosion killing firemen Calvin, Fear, and Jones, who were asleep in the forecastle. A fourth fireman, named Fadleigh, was fearfully scalded."

This is part of the life of a marine engineer, but the paragraph cannot depict the scenes below in times like those quoted above.

◆

YOU have doubtless read of strong men in various parts of the country who were able to lift from one ton to one and a half tons! Well, several of them met recently at the office of a paper in this city, where there is a 1,000 lb. weight and an offer of $500 to any one who can lift it. This is the result:

> Each of the giants of strength were confident they could win the prize by lifting the bell. By way of exercise they put up the champion club, weight 2[illegible]0 lbs., and then tried the big bell. The German champion, who lifts 1,300 with the health lift, and 3,[illegible]00 with harness, and puts up a 350 lb. dumb bell, made a great effort to lift the bell. He had several trials, but finally gave up, claiming he did not feel well.

Eh!

◆

A ONE pole dynamo has been invented in France, and is said to work successfully. As every magnet must have two poles, so far as known at present, it is a somewhat contradictory machine.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

PROPORTIONS OF ENGINE BEAMS.

Editors ENGINEER:

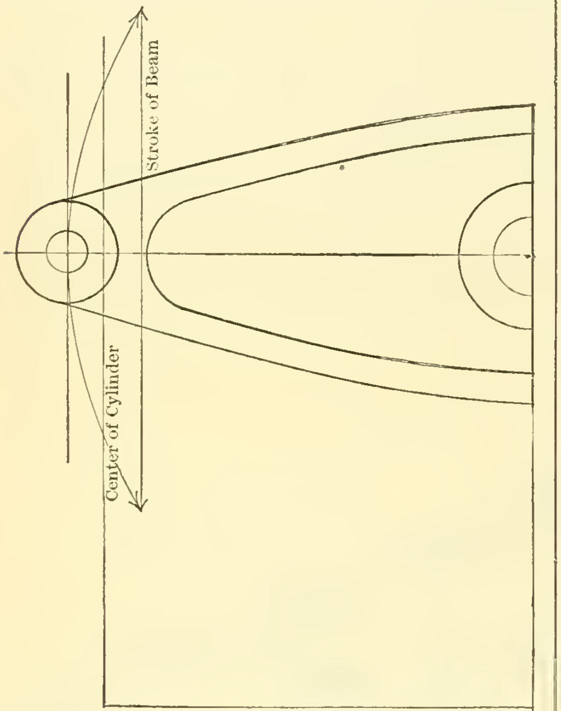
In an old engineer's note-book, which I came across recently, I find this question: "You are in need of a beam in great haste; you know that there is an old beam stored away belonging to the engine; in looking for it you have found two beams, one of 20 feet and one of 20 feet 6 inches in length. The stroke of the engine is 8 feet. How will you determine which of the two beams belongs to the engine which you want to get ready in great haste?"

For the benefit of a reader of your paper, will you please publish the manner of determining which of these beams is the one belonging to the engine.

W. F. STANLY.

Philadelphia, Pa.

[This is a catch question. Beams are not so numerous about works that they are lying around by twos and threes of different sizes and lengths. The proportions of beams for engines is usually twice the length of the stroke; less than this makes too great angle at the extremes of the stroke. A beam 20′ long, or a beam 20′ 6″ long would answer for a stroke of piston of 8 feet; the latter would be the best, but the whole matter depends upon the distance from center of cylinder to center of gallows frame. Now, a beam placed on the half center and vibrated up and down, describes an arc, or portion of a circle at the end. A straight line drawn through the extremities of this arc makes a chord. Another straight line touching the outside of the arc gives two parallel lines. The center of the cylinder is between these two lines; then the beam-end vibrates equally on each side of the center of the cylinder. The crank end of the beam is the same usually; sometimes the center of the shaft is moved in toward the cylinder a few inches. Now if we want to know whether the beam is of the right length we measure the distances between centers and put the best end over the cylinder. The other end can take care of itself. The best end is that which coincides with the true center of the cylinder and the true center of the gallows frame or other support, plus half the difference of the vibration of the beam. The front links always stand in toward the frame on top and bottom of the stroke and out on the half stroke.



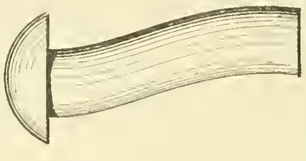
Supposing the engine had a parallel motion and no guides, then the beam length must be arbitrary, and is found by the method described, measuring the centers.]

◆

QUEER BOILER MAKING.

Editors ENGINEER:

Knowing that your paper is open to all, I would like to ask a question through it. There is a marine boiler owned by the firm that employs me that has caused a great deal of trouble and comment in the last six or eight months. The boiler is an upright, 5 feet by 10 feet, made of three-eighth steel, to carry 125 lbs. pressure to the square inch, built in 1888. For about nine months there was no trouble with the boiler, then the socket rivets began to leak around the heads, and the wise men began to prophecy. Some said grease, some said soda, and some said low water were the causes; others looked wise and said nothing. The first remedy that was tried was light caulking around the heads, but that amounted to but very little; in two or three days the trouble was just as bad as ever. Then they had some of the rivets taken out, and they were in this shape (they show for themselves). Now there have been about thirty-five rivets taken out, and they are all about the same, some a little worse, and some not quite so bad. The sockets were so loose between the sheets that you could shake them with your hand, and some of them were spread open one-eighth of an inch. The builders were corresponded with as to their opinion of it, and the satisfaction they gave was: "We expected to hear from it; we saw one of the engineers that ran it." Then they said that anyone that knew anything about it knew that the rivets could not be put in without being bent.



Now the query is: How could any engineer put the rivets and sockets in that shape, if he used all the devices that he had at hand for doing evil? There had been but two different engineers in charge of this boiler up to the eleventh of last October, and they are both almost total strangers to me, so I have nothing to say for or against them, but let us give them the benefit of a doubt until someone can show a method whereby they could have done the mischief. I would like to have some of the engineers tell us through THE ENGINEER their opinion, and would like to have boiler makers do the same. I would like to have our friend, Mr. John Cook, give us his opinion of such work.

Engineers do some funny things sometimes, but I cannot see how they did this mischief. C. E. J.

[Thanks for the information. The sketch shows the crookedness one way, but cannot show it every way. The bolt seems to have been a spiral straightened out, it is so crooked. It is not exaggerated in the least.—EDS.]

◆

POINT OF CUT-OFF.

Editors ENGINEER:

Please give plain rule, if any, to set the cut-off to work the most economically for any given engine and pressure.

CUT-OFF.

New York.

[So far as any rule applies, the only theoretical calculation which can be made is to divide the initial, or entering, pressure of steam by the terminal or exhaust pressure. This gives the number of expansions required. Suppose the pressure is 75 pounds by gauge, non-condensing engine, and the terminal pressure 8 pounds, then $\frac{75}{8}$ equals $9\frac{3}{8}$ths expansions, say 9. This would give a cut-off at one-tenth the stroke, which would manifestly give very little power. The terminal pressure assumed is lower than usual in automatic engines, and ten pounds would be nearer the average practice, which would give $7\frac{1}{2}$, or say 7 expansions. Builders of engines generally count upon a development of full power at 5 expansions in a single cylinder engine, but the coal pile is the final court after all.—EDS.]

◆

M. E. B. A., No. 38, SEATTLE, WASHINGTON.

Editors ENGINEER:

We have organized a M. E. B. A. here, and the membership numbers about 115 engineers to start with, out of about 250 on the waters of Puget Sound exclusively. There are about 100 on Alaskan waters and also about 50 at Gray's Harbor, which is about 100 miles south of Seattle on the coast. They will come into the association next summer.

The officers of our association are all gentlemen with energy and a determination to make it a success. The number is 38, M. E. B. A., Seattle, Washington. The corresponding secretary is C. J. Clark.

VIESTA.

◆

TWO LETTERS.

HERE are two letters, received in one mail. They illustrate so well one aspect of publishing a trade paper that we give them, suppressing names only:

FROM
NEW YORK STATE.

Your circular letter and copies are received. I delayed answering as our association do not hold meetings only during the winter months.

I certainly wish to see your paper prosper, and perhaps I may be able to help you some, but last spring I received an offer from —— of quite an inducement for new names, and have secured quite a number. Your paper is rather higher in price than ——, with a very small inducement for a person to make any extra effort to secure names, and "the engineer" is a person who does not read as much, perhaps, as he ought. But if you will excuse me, I will make a few suggestions which, perhaps, may be beneficial to you. In my opinion you can place your paper where you will, I have been interested in a paper enough to know the cost of extra copies. Just take some association (not this one) (nearer to New York than it is to the Pacific Coast), where none of your papers are taken; make your price for first year one dollar, and allow your agent one-half of that, which will pay him for some little time he may spend. You have lost nothing, and if your paper is good you will doubtless get two-thirds of the first year's subscribers for regular readers. Brother, you do not advertise your own paper enough, I never saw or heard of your paper, that I remember of, until within the last three months. Now, if you will try this, and let me know the result, I shall be pleased to learn it. With many apologies for my interference, I beg to bid you good day.

This is the second letter of its kind this year.

FROM
MONTANA.

Enclosed please find P. N. for $2.00 as a renewal of my subscription to THE ENGINEER. Your journal is a credit to you, and one which I have always admired for its outspokenness and straight-from-the-shoulder blows, delivered in behalf of the engineering fraternity at large. It is a godsend to a poor unfortunate, who happens to be becalued in these mountains. I have been taking great interest in your efforts on behalf of the man who drives the ship, and gets no credit when the boats arrive in port after a quick passage. I am sure marine engineers ought to feel grateful to you. I am a stationary man for the present, but I made my *debut* around engines on the Hudson River as "a dispenser of lubricants." I hope you will pardon this trespass on your time and good nature, but as I don't come often, why, maybe, you will overlook it this time, as I feel as if I was agent for THE ENGINEER in this vicinity, I being at one time, I believe, the only subscriber here. I commenced lending your journal to my fellow-engineers around here, and now I often hear some of them swear by (not *at*, mind you) THE ENGINEER to which they now subscribe. I shall endeavor to show my appreciation of your paper by securing subscribers, and putting in a good word in season. Should New York succeed in getting the World's Fair, I shall endeavor to take it in, so you may prepare to bear the infliction of my presence, for I shall certainly grasp the opportunity to get a look at the sanctum from which so much good sound horse sense comes; also at the man who compounds it; but, doubtless, this is becoming unbearable, so I will close; in the meanwhile look out for some new subscribers from this locality. Wishing you every success in 1890.

This is the 200th, or 300th letter of its kind this year.

Brothers in Seattle, Portland, Oregon, San Francisco, Eureka, California, Tacoma, and all along shore will be surprised to know that they do not read THE ENGINEER.

◆

COST OF ELECTRIC LIGHTING.

O. P. LOOMIS, an expert in such matters, says:

"The companies generally charge so much a lamp for the electrical outfit. Thus, suppose that a shop or an office building wanted to put in a system of 300 lamps. That would require an engine of 30 horse power, for the calculation is that one horse power will run 10 ordinary lamps. The best dynamos run 11 lamps per horse power. A good engine will cost, say, $750, set up. Then the dynamo, wire, switches and lamps must be provided by the company owning the system decided on. These will cost about $10 a lamp for 300 lamps, if for an office building or a hotel, but for a factory not over $8. The difference is in the finish of the brass work, trouble in running wires to the places wanted, etc. In a hotel much care must be taken in such matters. In a factory we have no hard-finished walls to take care of. A little over $3,000 would pay for a factory plant of 300 lamps. No account is made of the boiler, because in all buildings where such plants are wanted there is commonly a surplus of boiler capacity on hand.

"The lamps cost 80 cents each, and are warranted for 600 hours. An engineer fit to trust with a steam engine is capable of caring for the plant. The dynamo lasts a lifetime. So do the wires, and an intelligent boy screws on a new lamp when the old one wears out.

"The running expense of the system depends on the cost of coal. It takes practically about five pounds of coal per horse-power per hour in an ordinary building. If a good condensing engine is put in, then the consumption of coal is below that. A ton and three-quarters of coal should run 300 lamps twenty-four hours.

"If smaller plants are wanted, say twenty-five or fifty lamps, it costs from $12.50 to $13 per lamp for the electrical plant all in and ready to set going."

◆

CHIEF Engineer John P. Kelly, of the Navy, who was recently transferred from the Naval Hospital at Chelsea, Mass., to St. Elizabeth's Asylum for the Insane at Washington, died at the asylum recently. Engineer Kelly's health broke down some months ago when he was on duty on the '*Atlanta*' in the West Indies, and he was ordered home. He became rapidly worse in body and mind, and his death was not unexpected.

◆

IT is stated that the Strong Locomotive Company has decided to build extensive works at Cincinnati which will employ 1,000 hands.

THEY ARE NOT DEAD.

Not having heard much of them lately, we sometimes think that the mechanical hustler after impossible things, and the promoter of wild cat engineering schemes, are both dead, but we err therein. They are not dead, but still revisit "the pale glimpses of the moon." Here is evidence of the fact that we recently cut from a daily paper:

$500.000.000.—GREATEST FINANCIAL OPPORtunity on earth; power guaranteed one-tenth present average cost; unqualified approval U. S. Government experts; 250 patents and applications; only $50,000 wanted, preferably several investors; $1,000 for $1 inevitable; experts invited.

MECHANIC has invented machine giving power without cost; wants moneyed man to assist him to get patent.

Notice the "unqualified approval of U. S. Government experts" in the first advertisement.

It would be entirely unsafe to bet money that these persons will not be treated with by capitalists.

◆

A SIGNIFICANT PARAGRAPH.

A concern which makes a single-acting engine which has sold very largely says:

"The explanation we believe is found in the fact of the enormous investment, both of money and energy, which is necessarily required to bring about the result. No concern can hope to reach the point of successful competition without a similar investment, and what is even more discouraging, without the same hard won experience during the earlier years of its business. Entrenched behind these facts, it has not been necessary except in rare instances, for us to call upon our patents for protection against undue competition."

There is a whole sermon in these remarks, and they express the tendency of manufacturers nowadays who can command the capital to concentrate vast sums upon the manufacture and marketing of specialties. The sewing machine is an example, and doubtless there are many others Competition is rendered almost impossible without similar advantages, and since the same kind of operations would result in breaking the market for both parties, no one is inclined to molest the first occupiers of it.

◆

FAMOUS AMERICAN ENGINEERS.

Believing that it is of interest to all to know the pioneers in the profession of engineering in this country, we are making our readers acquainted with them, in so far as their portraits are concerned. We have been fortunate in securing their co-operation in our purpose, and shall continue to present them. All of the leading members of the profession, men famous for their work, have promised their photographs. We esteem it a privilege to present them as, with only one exception, that of Professor Thurston, none have ever been published before.

◆

Wires in the subways are encased in insulating material and then run in bunches through thick lead pipes, which are drawn through the subway holes. At the manholes these bunches of wires, done up in lead pipe, do not go straight across and out on the other side, but run down and under the bottom of the manhole and then up and out again. The lead casing is continuous, and there is no part of the wire exposed anywhere in the manhole. When repairs are necessary the workmen go down into the manhole and cut open the lead pipe to get at the wire they want. Plumbers follow them and seal up the cut. They are supposed to do it very carefully, for if they don't the moisture will get inside the lead pipe and destroy the insulation of the wires. If they are not careful enough, however, or if the job of soldering up the pipe where connection is made in the first place between different sections of the bundles of wires is poorly done, there may be left a hole, perhaps no bigger than a pin hole, leading through the joint in the lead pipe to the wires inside.

◆

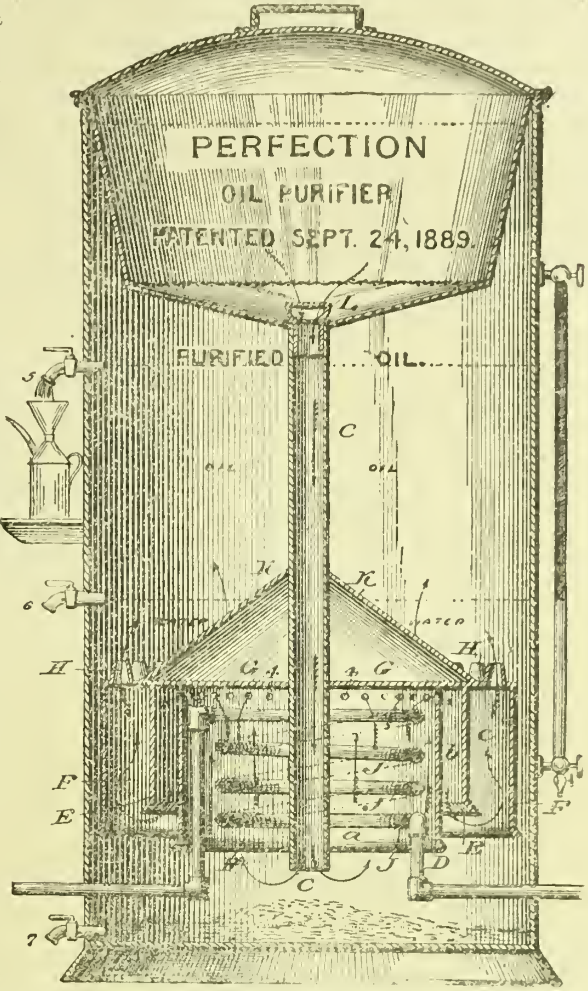
Northern men who went to the marine engineer's convention at Charleston, S. C., found June weather and plenty of musquitoes. They had no use for the latter.

◆

Skates seem to be superfluous this year.

THE PERFECTION OIL PURIFIER.

A very simple and efficient system for purifying lubricating oil of all impurities has been invented and is here illustrated. It is applicable to all oil, whether used previously or fresh from the barrel. A good feature of it is that it is wholly independent of any filtering materials or agents, such as charcoal, cloths, etc., etc., the action being based upon the relative differences in gravity of water and oil. The oil is poured into the tank on top, from whence it passes down through the tube *c* to the steam-heated coil in the bottom. This renders the oil perfectly limpid, so that it throws down mechanically all foreign substances that may be in it. The oil then passes down through chamber *B* and up again through chamber *c*, and from thence to discharge pipes *H*, after which it rises through the water chamber into the tank, during which passage it is washed clear of anything not thrown down previously. This system, it will be seen, purifies the oil, it does not filter it in any way, and it is claimed that the dirtiest oil from drip pans may be made useful again by this system. This apparatus is for sale by W. B. Brook & Co., 47 Murray Street, New York, who will furnish price lists.



◆

There seems to be a prevailing idea among many proprietors that anything that can be poured upon the journals provided it is cheap, is a good enough lubricator, but this is a mistaken idea. The old maxim, "the best is the cheapest," is as applicable to the oils used in a planing mill as to anything else, and the oil that is used, no matter whatever it may be, that is free from gum, and will give the best results with the least amount used, is the cheapest in the end, no matter what the cost may be per gallon. There is no doubt but the reckless and wasteful use of oil that is indulged in by the operators in many mills has led the proprietors into purchasing a cheaper article under supposition that the operator will use about the same quantity regardless of the quality. But this is not always necessarily the case.—*Age of Steel.*

◆

"A subscriber" sends us an unsigned letter which we should be glad to publish if we knew whom it was from. Anonymous letters cannot receive attention. We have said this a good many times lately.

CHEEK IS NO NAME FOR IT.

Some few issues back, the *National Car Builder* warned inventors not to do business with patent venders, who, under the pretence of selling, only defrauded them. One of these concerns copied the article with approval, and then adds that they do not ask any fee in advance; they are "satisfied with a fair commission" in case of success. In another part of their advertisement they announce that a fair commission is 33 per cent. on the sale of the patent, and 25 per cent. where arrangements are made to manufacture on royalty. Considering that an inventor is very fortunate to obtain 25 per cent. on the profits of an invention sold upon royalty, it would be interesting to know how he is to pay the agent 25 per cent. "during the life of the contract."

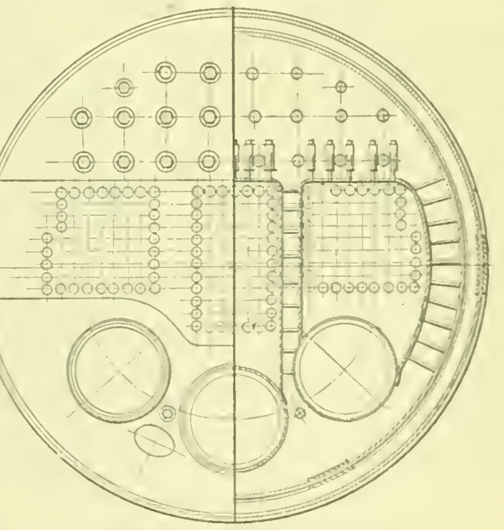
Women are sometimes laughed at for their want of business capacity and knowledge of detail in mercantile transactions, but here is a patent agent, or, rather, a vender of patents, who boldly claims 25 per cent. of the profits, leaving the inventor and manufacturer to share the other 75 per cent. as they can agree. Cheek is no name for it.

◆

A PECULIAR MARINE BOILER.

What seems to us an extraordinary proposition is that shown by the engraving. An English engineer, feeling that the present Scotch marine boiler is too large and heavy with its $1\frac{1}{4}$ inch shell plates, proposes to reduce the weight by making two shells, each $\frac{5}{8}$ths thick, the space between the outer and inner shell being filled with steam of a less pressure than that carried in the boiler proper. Supposing that 250 lbs. per square inch is carried in the boiler itself, the inventor proposes to carry 150 lbs. in the space, thus relieving the strain on the inner shell. He has a system of reducing valves by which he always maintains the same relative pressure. We cannot see any material difference in two shells $\frac{5}{8}$ths of an inch thick and one shell $1\frac{1}{4}$ thick as regards weight, except that the two shells would weigh more than the single shell, for certain dimensions must always be given the boiler proper, the external shell being, of course, much larger.

The inventor says: "Safety valves of ordinary construction would have to be provided for both boiler and jacket. Condensed water would be drawn away from the bottom of the jacket to feed the pumps. Tubes would have to be thicker, but not much more so than those required for 150 lbs. pressure, as their diameter could be slightly reduced. The same may be said of furnaces. These could be used of a thickness of $\frac{5}{8}$ in. and diameter of 3 ft., and of a thickness of $\frac{9}{16}$ in. and diameter of 2 ft. 6 in. Longitudinal stays would have to be pitched closer together and of rather larger diameter, but they need not be of lesser pitch than 14 in., which would afford ample room for examination and cleaning inside of boiler. Combustion chamber stays would have to be pitched closer together and of rather larger diameter." And so on all through the structure. It seems to the old fogies as though the gain claimed was rather chimerical.



THE ENGINEER.

FORTNIGHTLY. · · · $2.00 PER ANNUM.
Foreign Subscriptions, - · · · · · 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

Vol. XIX. NEW YORK, FEB. 1, 1890. No. 3.

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Entered at the New York Post Office as Second Class Matter.

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INSPECTORS' QUESTIONS.

Complaints are rife among engineers of both classes, marine and stationary, that questions are asked them by inspectors which have no connection with their duties; and determine nothing whatever as regards their fitness for positions. Here is such a question, which we are assured was asked an engineer at police headquarters in this city quite recently:

"Suppose you had a boiler of certain dimensions, how much water would it hold, and how much steam would that water make?"

The reply of the candidate was that he did not know, and, he added to the inspector, very justly, "If you shut that book up you don't know either." The inspector retorted that the candidate was both ignorant and impertinent. Now, it seems to all unprejudiced persons, that this is entirely outside of the matter of examining candidates for positions as engineers. In the first place it is not at all necessary that a man should know how many gallons of water his boiler holds; neither is it necessary for him to know how much steam it will make—a question by the way which is wholly meaningless, unless pressures are given. An engineer in charge of ordinary plants is not supposed to be a mechanical engineer, and it is not necessary that he should be. He is engaged solely to manage safely and economically the machinery in his charge, and he has no more to do with the gallons of water in the boiler than he has with the water which may or may not be in the moon. All that he is required to do is to keep water in the boiler at a certain height and to burn the fuel given him economically, combined of course with other duties which it is not necessary to detail at length now.

The candidate particularly mentioned here was quite correct in saying that the inspector could not answer the question himself. Neither could he—book or no book. Given a cylindrical vessel of a certain size, and it is easy enough to ascertain its cubic contents, whether the vessel be full or half full, but when it comes to a boiler full of water up to a certain line that is a very different matter, and to even approximate to the contents within fifteen per cent. is little better than guessing. If there are tubes in it their superficial areas must be subtracted, so must the braces and staybolts, if any, under water; so must every bolt head and hand-hole plate under water, for all these displace water. It is, therefore, absurd in any other light than that of a mere catch to ask an engineer flatly how much water a boiler of a certain size will hold unless every dimension exposed to water is stated. The question about the steam made from so much water is equally meaningless and wrongly put. It might be asked of a candidate not improperly how much steam at atmospheric pressure can be made from a cubic inch of water, because this is rudimentary, and within the reading of any man who reads at all, but even this has nothing to do with an engineer's duties, which are chiefly the safe management of the power entrusted to him. An inspector has no right to go beyond this and ask desultory catch questions, which the inspector himself knows nothing about, except by rote or as a parrot talks. The object and end of examinations is to discover whether men have had the experience they claim to have, or whether they are mere pretenders, and to find this out requires an inspector to have had long experience himself. A very large number of them have had none at all, and they could not pass an examination for the care of the simplest plant, if rigidly examined. What answer would the average inspector make to such a question as this:

"Suppose you were standing by the boiler and heard one explosion after another inside of your boiler, what should you think it was, and what would be your action at once—instantaneously?"

The inspector would not and could not answer, unless he had been there before. Yet every practical engineer of experience would answer promptly that the braces were letting go, and he would let the pressure down at once, until he found out what the trouble was.

There should be some restriction as to the nature of the questions asked by inspectors. They should be limited to developing the actual practical experience of the candidate, and should not be directed to alleged philosophical queries, or to excursions into sciences which working engineers have had no opportunity to become acquainted with, and which lie wholly outside of their duties.

Many inspectors, indeed, seem to think it their business to place every obstruction in the way of candidates obtaining licenses, when they should—to do their duty—use every means to enable a capable man to get a license.

ALWAYS ON WATCH.

If we were to accept all the courteous invitations tendered us to go here and there which our friends shower upon us we should seldom be in this office. No doubt the office would be all the better for it, but — "whoso by the plough would thrive, himself must either hold or drive," and that is the only reason we can give for not going to Cornell University, to the Engineers' Club reception, to visit new ships and shipyards, and, in short, journey all over the continent. The mere contemplation of such journeys is delightful, and we are sure that the realization of them would be far more so, but it unfortunately happens that a man cannot be in two places at once, and we have never been able to find a man who would, for a short time only, take our place. We have tried experiments in this direction to our sorrow, and have no desire to try any more. Ixion was chained to the wheel, and had to go around with it whether he would or no, and an editor who attends to his business is compelled to be in his office six days in the week during business hours. There are those who think that a paper edits itself, and is chiefly made by printers and pressmen. There are some of this class, we admit, but The Engineer is not one of them, as our friends can attest. The spirit is willing enough, but the circumstances will not admit of prolonged absence, and that is why we are always on watch, trying to do our work as well as we can.

A MISTAKE.

It is a mistake to blow a steam boiler off, either for steam or water, as soon as possible. As regards relief from steam pressure, it is particularly injurious to the boiler, for the reason that, when pressure is on, the whole fabric is under extreme tension at all points; it is also highly heated, and has, in addition to the absolute pressure of the steam, that due to expansion, which latter is a tremendous force. If, now, the pressure is removed as soon as it can be, the boiler is cooled off suddenly, or within a short time, and not at all equally or evenly, with the result of entailing local strains, which affect the durability of the boiler. Of course, rivet heads do not fly like grape shot, nor braces snap suddenly. Seams do not gape and yawn, neither do the heads dish or collapse. The boiler does not go to pieces on the spot, but for all that it is shortened as to its life, and repairs have to be made sooner than they otherwise would be if the boiler was treated intelligently.

Pressure should not be relieved suddenly, but gradually, and it will be noticed that this is done by all engineers of long experience, either on shore or on board ship. The safety valve does not roar like a lion with them; it sings like a teakettle, and the pressure gradually subsides, while the boiler just as gradually cools off. That is the way to keep boiler makers off the premises.

◆

A Californian industry which seems to thrive is train robbing. The frequency of these occurrences leads one to wonder how it is possible for the express companies to exist.

FAMOUS AMERICAN ENGINEERS. No 5.

ROBERT H. THURSTON, DIRECTOR OF SIBLEY COLLEGE, CORNELL UNIVERSITY, ITHACA, N. Y.

Robert H. Thurston, formerly of the United States Naval Engineer Corps, later professor of engineering, and always a practitioner, was born in Providence, R. I., October 25, 1839. He is the son of Robert L. Thurston, who built his first engine in 1821, and founded the Providence Steam Engine Company, as it is to-day called, in 1837.

Robert H. Thurston, his son, the subject of this notice, was educated at Brown University, class of '59. He received, during youth, a useful practical education in his father's workshops, and this practice continued throughout his early life. When he left college, in 1859, he was familiar with the work of the draughtsman, designer, pattern maker, moulder, the forge, and machine shop. He also did a considerable amount of work in the design and construction of the Sickles and the Greene engines, which were built by the firm.

Two years of business in the shop and in the market selling engines for the firm of Thurston, Gardner & Co., followed his graduation; then the war broke out, calling the best men of the country into army and navy.

Mr. Thurston applied for appointment in the engineer corps of the navy, passed examination in the summer of 1861, and was ordered to duty on board the '*Unadilla.*' Mr. Thurston was senior assistant, and had charge of the engines during action. He remained attached to the '*Unadilla*' about a year, and was finally sent North in charge of the machinery of the '*Princess Royal,*' a blockade runner.

Mr. Thurston having been reported for gallantry, and to have exhibited creditable qualities as an engineer, was immediately upon arrival at Philadelphia ordered before the Examining Board for promotion, and sent back to the fleet as the engineer-in-charge on the U. S. Ss. '*Chippewa.*'

Immediately after his service in, and detachment from, the '*Chippewa,*' he was ordered, as engineer-in-charge, to the '*Maumee,*' but was on this ship only a short time, when he was again detached and sent to the '*Pontoosuc.*'

Detached from the '*Pontoosuc,*' on her return from a cruise, Mr. Thurston was ordered to the ironclad '*Dictator,*' our largest monitor. When the ship went to sea it was found that she was a most comfortable seaboat, but that the engines, designed for what was then thought very high speed and power, were liable to serious heating of journals. A year of service on this remarkable vessel ended the active sea service of the subject of our sketch.

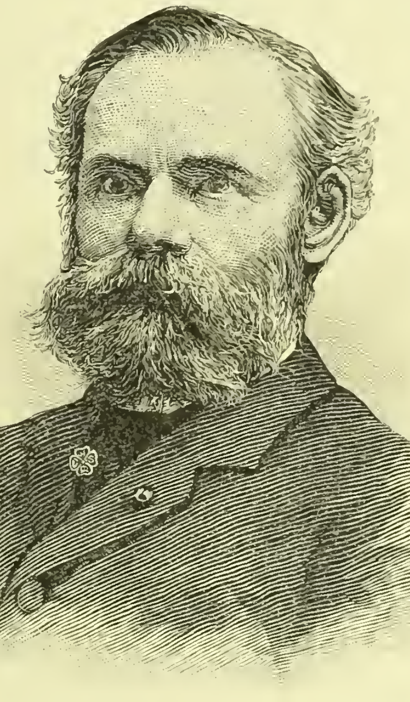
During all this varied experience he had also had unusual opportunities for observation, and some for further pursuit of his professional and general studies. He had been again promoted while on the '*Dictator,*' and the war closed about the time that he received his commission as a "First Assistant Engineer," a rank corresponding to what is now known as "Passed Assistant." During this time he had, on many occasions, taken part in experimental investigations, which, under the direction of Engineer-in-Chief Isherwood, were made on every type of engine and boiler at his disposal, and the records of which to-day constitute so important a part of the literature of experimental engineering.

January, 1866, found Mr. Thurston at the office of the Commandant of the Naval Academy at Annapolis, reporting to Admiral Porter for duty in the Department of Natural and Experimental Philosophy, as an acting assistant professor. He was detailed to duty in instructing classes under Dr. A. W. Smith. The death of Dr. Smith, within a few weeks, placed Mr. Thurston temporarily as senior officer in the department, and he was compelled to direct its operations, and to assume the duties of lecturer on chemistry and physics, which duties he continued to discharge for several years. He was six years continuously on duty at the Naval Academy.

In July, 1871, Mr. Thurston accepted an appointment at the school of mechanical engineering at Hoboken, and for fourteen years filled the chair of engineering in the Stevens Institute of Technology, resigning his commission in the navy in 1872.

He organized, about 1873, or earlier, what was probably the first mechanical laboratory for research in engineering that was ever founded; and, for the dozen years succeeding, kept it employed constantly in the investigation of problems of practical importance. He was, meantime (1875-'8), a member of the U. S. Board appointed to test iron, steel, and other metals, directed the greater part of the work completed by that board, and, as its secretary, edited its reports. His investigation of the laws of friction and of properties of the alloys of copper, tin and zinc, which resulted in the determination, by a new and ingenious method, of the relative values of all combinations of those elements, were perhaps the most striking, original, and famous of these researches.

Professor Thurston was a member, also, of the U. S. Board appointed to ascertain the causes of steam boiler explosions, but was unable to serve more than a single season, on account of ill health. He did, however, take active part in the work of the Board during its most productive period, and had already taken part in the preliminary work of Mr. F. B. Stevens on the collection of large steamboat boilers afterward tested by the Board at Sandy Hook, N. Y., during his connection with it. His papers on "Experimental Steam Boiler Explosions," and his later works, "A Manual of Steam Boilers: their Design, Construction and Operation," and his treatise on "Steam Boiler Explosions in Theory and in Practice," embody a part of the data and information there secured.



In the year 1873 Professor Thurston was appointed a member of the Scientific Commission of the United States to the International Exhibition at Vienna. He was also a member of the International Jury, and assisted in securing recognition of our claims to superiority in all departments of machine construction.

In July, 1885, Professor Thurston was solicited to assume charge of the mechanic arts department of Cornell University. It was proposed to create a school of mechanical engineering and the mechanic arts, to create a directorship, and to make of Sibley College a real college of engineering. Professor Thurston was asked to reorganize the college on the enlarged basis.

The offer was accepted, and Professor Thurston left the Stevens Institute, receiving as testimonial of affection the Doctorate of Engineering from the faculty and trustees. He took charge of Sibley College, reorganized it, created a department of mechanical engineering, readjusted the older departments, and saw immediate results in the rapid growth of Sibley College. Dr. Thurston was the first president of the American Society of Mechanical Engineers, has been for many years a member of the American, French, Scotch, German and Austrian Societies of Civil Engineers, of the British Institution of Naval Architects, the American Institution of Mining Engineers, of which he is also Past Vice-President; the American and British Associations for Advancement of Science, three times Vice-President of the former, and once of the latter (Montreal, 1884), and of other scientific and technical associations at home and abroad. He is a member of the "Loyal Legion," and is "*Officier de L'Instruction Publique de France,*" and was given the degree of LL.D. by his Alma Mater, Brown University, on the thirtieth anniversary of his graduation.

He has been an extensive writer, on professional subjects mainly, his papers numbering something like 250. and he writes some articles of a speculative character. He is the author of many books, including a "*History of the Steam Engine,*" a three-volume treatise on "*The Materials of Engineering,*" a treatise of "*Friction and Lost Work,*" etc.

Dr. Thurston has, during the thirty-three years of his technical work, kept up a line of professional practice which has been extensive and lucrative; but the pressure of his regular duties have induced him to restrict that branch very greatly. He still remains a practitioner, however, and, some years since, refused election to membership in the British Association of Civil Engineers as Associate, on the ground that he could not accept a rating that would indicate him to be other than an engineer in practical touch with his profession. Mr. Thurston has always intended to make the practice of his profession ultimately his exclusive vocation, and has only been witheld by what he has considered exceptional opportunities to be of service to his profession and the world in the inauguration of schools of engineering, and the promotion (wholly effected since his college days) of the mechanical engineer to a really scientific engineer, and to establish what has come to be universally recognized, a *profession* of engineering, in which a better and more thorough education and a more precise and scientific training is demanded than in any other of the existing professions. The profession of engineering is to-day, even more than the older professions, a learned profession, and it is his pride that he has been able to assist in effecting this great advance.

Dr. Thurston is still at Cornell University, Director of Sibley College, and Professor of Engineering in that institution; he is giving all his leisure, apart from his regular duties and the calls of social life, to putting into permanent form facts and data accumulated during a professional life of exceptional opportunities, and publishing the material which he has gathered during the last thirty years. He has published about one volume a year, for now, ten years, and expects to to continue, health permitting, until he has accomplished much more long since planned.

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W. H. Chapman, Portland, Me., has constructed a dynamo and motor that can be run at a low speed. It can be used either as a dynamo or as a motor. When tried recently it ran at about 150 revolutions a minute. The ordinary motor has to run at a high speed in order to develop power. The principle involved is that instead of having only two magnets, as in the ordinary machine, there are a large number of magnets arranged about the periphery of the armature. The name of the machine is the multipolar-motor, which itself explains its construction. It seems to us that we have heard of dynamos like this before,

FIFTEENTH ANNUAL CONVENTION OF THE MARINE ENGINEERS' BENEFICIAL ASSOCIATION.

THE Fifteenth Annual Convention was held at Charleston, S. C., this year, and was one of the most successful of the series. The brothers at Charleston spared neither pains nor expense to render the affair pleasant to all, and it is the unanimous opinion of all that they did so. The sessions were held at Hibernia Hall, and the delegates were welcomed to Charleston by Bro. Maurice Maguire, delegate of No. 65, Charleston, as follows:

"Mr. President and Brother Representatives of the National Marine Engineers' Benevolent Association: As president and representative of No. 65 of Charleston, it becomes my duty to welcome you to the City by the Sea, which I do with all my heart. The National Association has honored our dear old city by holding their convention here. Words cannot express the joy we feel at meeting you. I am confident that our deliberation will be harmonious and I sincerely trust that you may enjoy your visit and make yourself at home. For I can assure you, brothers, that our hearts and homes are opened to you. We esteem it a proud privilege to have you our guests, and now to conclude allow me the honor of introducing to you the Hon. George D. Bryan, the Mayor of our dear old city."

After the Mayor's remarks Ambrose L. Boyes, National President M. E. B. A., responded in fitting terms, saying among other things:

"In looking over statistics I find that there have been in the State of New York alone, since 1881, 9,247 strikes ordered, 8,716 of which were by labor organizations. These strikes involved 9,247 establishments, 4,717 of which were closed for an average period of fifteen days. Of the total number of strikes 4,720 succeeded, 759 partly succeeded, and 3,759 failed. The total loss to employees aggregated $8,581,784, and that of employers, $5,966,421. The sum of $726,636 was raised by labor organizations to aid strikers. In these strikes 376,584 employees were involved, and the places of 24,889 strikers were taken by new employees, of whom 4,581 were brought from other places; 1,528 lockouts were ordered in the same period, closing an equal number of establishments. Of these 180 only succeeded, 137 were partly successful, and 1,090 failed entirely; the loss to employees was $3,150,123, and to employers $845,262; $396,320 was raised to support the locked-out employees. Of the total number of strikes occurring during this period, 3,410 were owing to demands for increased wages, while 2,993 for a reduction in the hours of labor. Of this latter number, 1,752 occurred in the tobacco trade alone.

"With these facts before us, it seems to me that we have material for serious consideration. Capital and labor must go hand in hand, to succeed in the great struggle for existence and subsistence. No stand and deliver policy will ever succeed by either side. Labor is a marketable commodity and will command its price according to its quality and quantity, and if the employer studies his own interests, as is natural, he will secure the best in the market and upon the best terms. As marine engineers we mean to put upon the market the very best material, and improve upon it from time to time, that those who purchase may get full value for their money.

"I deny any assertion as to our being a labor organization, in the general acceptance of the term. But I at the same time claim that we are a protective organization; protective to ourselves and protective to our employers, and protective to the public at large; for in our hands are placed millions of valuable property and millions of valuable lives. Daily we seek by our organization to qualify ourselves for the purpose of filling all the requirements of our position, and all we ask at the hands of the employers and the public is justice, as we deserve it—no more, no less."

After the foregoing speeches, representatives George Uhler, of New York, J. H. Mittendorf, of Baltimore, and J. J. Quigley, of Boston, were appointed a committee on credentials, who subsequently reported the following delegates as entitled to seats: J. H. Galwey, D. C. Martin, G. R. Congdon, C. I. Coon, Robt. G. Davis, Jno. H. Adams, J. H. Mittendorf, J. H. Reid, E. A. Tucker, Philip Phinn, Maurice Maguire, J. J. Harrison, Geo. W. Rouse, J. J. Quigley, Walter F. Von Guying, Jno. P. Flannery, Geo. P. Wilson, J. B. Wood, J. Geo. Hermes, J. H. Harris, M. T. Coghlan, Jno. C. Drew, Joseph Brooks, T. C. Little, Robt. H. Jones, W. E. Masters, Andrew M. Lester, John F. Dowd, C. M. Stoddard, F. D. Cook, George Uhler, James T. Godwin. The proceedings were then opened and Mr. George McMaster was appointed national conductor, Maurice Maguire doorkeeper, Geo. R. Congdon assistant secretary, and Geo. W. Rouse chaplain. All the officers were present. After a few remarks from the Chair, relative to the work of the Association, a resolution was passed fixing the hours of session from 9 A. M. until 2 P. M. daily. The following cablegram from A. R. Leaske, secretary of the British Union of Engineers of London, was received:

"*The British Marine Engineers send kindest regards to their American brethren.*"

This was replied to by President Boyes.

The second day's proceedings were opened at 9 o'clock, and the Convention got right down to business. The various committees appointed were as follows:

On Secret Work—J. H. Reid, T. F. Dowd, P. F. Wilson. Expense of Officers—D. C. Martin, W. F. Von Guysling, J. J. Hermes. Per Capita Tax—J. J. Quigley, T. C. Little, John P. Flannery. Appeals—Fred D. Cook, J. T. Godwin, G. R. Congdon. Auditing Committee—C. M. Stoddard, E. W. Tucker, James Brooks. Constitution—A. M. Lester, C. H. Stoddard, R. H. Jones. Statistics—George Uhler, John Durr, M. T. Coghlan. Legislation—George P. Wilson, J. P. Flannery, J. J. Quigley, D. C. Martin, James H. Reid. Finance—F. D. Luke, W. F. Von Guysling, M. Maguire, Walter E. Masters. Boilers and Machines—John H. Adams, John Durr, J. B. Wood.

After the appointments President Boyes' annual report was read, giving succinctly the history of his administration. There were also read the reports of the past president and vice-president.

The reports of the various sub-organizations were then read. These reports showed that the membership is largely increased, and, financially and otherwise, the various organizations are being developed.

The following resolution was adopted:

Resolved, That this Association hold memorial services, commencing 12 M. on Thursday, the 23d inst., which the public is invited to attend.

The deceased members were F. W. Whitehouse, J. E. C. Kinsland, James Marchon, C. W. Bilderback.

The excursion around the harbor and to points of interest tendered the visiting delegates was greatly enjoyed by them, but the crowning feature of the civic part of the Convention was the banquet given to the delegates by No. 65 M. E. A., Charleston. This was really a magnificent affair, and was characterized by the usual features of such occasions. The speeches were numerous and well considered, and not a thump or pound was heard. Nobody got hot and everybody followed full stroke. Plenty of steam was made and everyone had a good time which will long be held in remembrance. The toasts and speeches cannot be recorded here, but the banquet was a great success in every respect. The following gentlemen composed the committee of arrangements: John A. Quinlivan, chairman; Herbert W. Sassard, Maurice Maguire, John O. Moisson, Alexander Wilson, John Doig, John Jones.

DECISIVE ACTION.

Owing to the great length of the sessions, and the varied character of them as regards proceedings, it is impossible for us to do more than present a summary, leaving the brothers to find the details in the official *Journal of Proceedings*, published by the Association. The order of exercises on Thursday, Jan. 23, embraced the following:

Resolved, While our Convention has been in session in this, one of the great and progressive cities by the sea, and in the Palmetto State of the United States of America, we duly appreciate the honor accorded us, and general good will and bountiful hospitality of the brothers to the representatives and visiting brothers of this Convention of the Marine Engineers' organization, and that we are especially thankful for the personal efforts of the members who contributed to our entertainment and instruction while here.

The memorial exercises in honor of deceased brothers was a fitting tribute to their memory, and after prayer by the Rev. C. E. Chichester, D. D., chaplain of the Sailors' Bethel in Charleston, addresses were delivered by Messrs. Geo. P. Wilson, P. N. P., James H. Reid, P. N. P., D. D. Martin, W. V. P., James Henry Harris, N. S., John H. Galwey, N. T., and Representatives George Uhler, R. G. Davis, George R Congdon, Jos. Brooks, E. W. Tucker, Thomas R. Dowd, J. J. Quigley, Maurice Maguire, W. E. Masters, and Geo. W. Rouse.

Later in the day the business of the convention was resumed, and it was resolved to make

THE OFFICE OF NATIONAL PRESIDENT A SALARIED ONE.

This was done, and Bro. John H. Galwey, Detroit, formerly National Treasurer, is the President-elect for 1890, and will devote his whole time to it. In our opinion no better choice could have been made for the interests of the Order at large, and in saying this we are by no means unmindful of the good qualities of other candidates who had strong claims to the consideration of brothers. National President Galwey has a great advantage in his central location, for, living in Detroit, he is the center of a great circle, and can reach localities on all sides of him much more readily than an officer on the Eastern seaboard. Moreover "turn about is fair play." Three National Presidents and one National Vice-President have been elected from the Eastern coast in three consecutive years, and it is only right that Western brothers should have a sitting. National President Galwey is not a whoop-'em-up man, nor much on the hurrah, but he is a very solid worker, and a reliable, conservative standard bearer, who will hold the flag of M. E. B. A. high up. He is above any petty prejudices or silly spites, and will fill the office conscientiously and creditably. In witness hereof is our hand. The President's salary is $2,000 per year.

National President Galwey has our sincere congratulations personally, and good wishes for the success of his reign. Let him command us, and we will do all we can to serve him and the Order at large. The officers elect are:

National President, J. H. Galwey, of Detroit.

National Vice-President, E. W. Tucker, of San Francisco.

National Secretary, James Henry Harris, of St. Louis.

National Treasurer, George H. Uhler, of New York.

Brother Tucker it has never been our good fortune to meet, but he has our good wishes and co-operation. Brother Jas. H. Harris knows us already; same to him. Brother Geo. H. Uhler ditto. The delegates could not have picked out a better man for the office.

The next convention will be held in Washington, D. C., and it is safe to say will be one of the largest and most enthusiastic ever held. It will be very hard to beat this one just held at Charleston. The brothers of the Palmetto City have certainly outdone themselves in their achievements.

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A DOWNEAST paper which directs attention to its articles on engineering, and boasts of "a mechanical laboratory" (by which it means a small machine shop), says: "Momentum is a word used to express the quantity of motion in a moving body," etc., etc.

It is, eh? Well, how do you express the quantity of motion? Is it by pounds, quarts, feet, or inches? What is a foot-pound of motion? Momentum used to mean the force of a body in motion once, and we don't think any better definition has been found since.

The same article refers to Prof. Richards, of Yale, inventor of the Richards Indicator, as though he was contemporaneous with Watt. "In the days of Richards," "Since the day of Richards," etc. Richards' day is the present day, young friend.

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PISTONS are still made upon the wholly erroneous view that it requires a solid chunk of iron in the cylinder to receive the force of the steam. These pistons are supplied with various sorts of togglejoint rigs to get all the pressure possible on the packing rings. The man who buys the coal has to pay for this foolishness.

IN HARD LUCK.

"I WRITE to give you an account of the troubles I have had during the two voyages I have been in this ship. At the beginning of last voyage, before we got into the Channel from Cardiff, the vacuum fell, and with the arrangement of pumps we had to disconnect everything before we could look at the valves. Things went fairly well again until in the Red Sea, when the h.p. slide kept seizing, which beat the liner out in eccentric sheave, and burst the side out of the eccentric, so, of course, we had to stop and pin the liner on the strap. The next thing we did was at Zanzibar, when we drew all the tubes out of the condenser and got nine buckets of solid grease out of it. After leaving Zanzibar we could get twenty-five inches of vacuum, which before was impossible. Two or three days after leaving Zanzibar, the bolts broke in after tunnel coupling. We stopped and put a new set in, but these broke before we had run two hours, so we fitted drivers or bolts to act as drivers, which would do to drive the ship as long as she went ahead.

On our way to Bushrah I told the captain not to go astern, but in spite of this he did so, for he rung the telegraph and we were forced to obey; the consequence was that the couplings parted and the length of shafting next the engine went round a coupling bolt like an eccentric, bent one length of shaft, and broke the cap of plummer block and tunnel top. He said his reason for going astern was that he was going ashore, and was forced to. Now, he knew how we were placed, and he had plenty of room to go or keep farther out. On examination we found the bush worn down to only one-sixteenth of an inch thick on bottom. Well, this bush was cut out and a new one cast and relined at Bushrah, where we also put spare tail and shaft in with new brush.

We ran home without the after plummer block, there being keys sunk in the flanges of the two after couplings with a wrought-iron band round, and in this way we ran safely to Cardiff. While there, we had new tail end shaft, bush relined, new ends put on top and bottom end bolts, new end on connecting rod (h.p.), two pair new top end, and one pair of bottom end brasses. The piston rods had humps on them, but the superintendent would not have them taken out, nor the cylinders bored out, which were over one-quarter of an inch oval, nor would he have new bushes put into stuffing-boxes, nor a new gland for the h.p. one, that was in pieces, for all they were a quarter of an inch larger in diameter; water had to be run on the outside of the crosshead shoes to keep them cool, as the pipes in the columns were blocked, and even if they were clear there were no pipes to lead water to them. Also at Cardiff I was told to compress the safety valves five pounds extra, mind you—boilers twelve years old, at a pressure of seventy-five pounds now.

Some time ago the crowns had been down. They had been straightened and the combustion-chamber back put in three pieces; well, the bottom of the third plate, or more correctly, the seam joining the second and third plate, counting from top, had been that much pared and caulked that there was very little metal left to tighten the seam, and at the end of a voyage there was always about a week's work for two out of the six men, including donkey man. The salt would accumulate to the top of furnace bridge solid in a voyage—I mean to say in a run from here to Singapore—and the bridge, bridge-plate, and bars have all to come out before the salt can be got at.

On leaving Cardiff this voyage, we just got outside when the knocking of the h.p. top end was so heavy we had to stop and take bottom brass out and chip three-sixteenths of an inch off its edges before we could go on. On the way to Constantinople the turning gear wheel fastening bolts were dropping out, and we had to stop and put them in; this wheel having been put on at Cardiff. At Constantinople new tightening screws had to be made for both sides, and the windlass repaired. After leaving Batoum, and on the way to Singapore, the sailors, in cleaning No. 1 winch port side cylinder, knocked a hole in it, so we had to replace it with a new one on board. In the Indian Ocean, going out, the steering gear chains of steering wheel kept slipping off gipsy, and in going through the canal No. 2 winch starboard cylinder blew through bottom of steam chest (through walls), the hole having rusted through.

In entering the Port of Cebu, Philippine Islands, the captain mistook the bamboo sticks in the water and went too much to the right, and before they knew what they were doing ran upon a coral reef, and he blamed me for not stopping the engines or reversing them quickly enough, which was all nonsense, as we were on the reef before he rang the telegraph bell, and we had then fourteen complete turns to make with a hand-wheel before she was reversed, and he said we were four minutes before the engines went astern, which was not correct.

From Singapore we went to Kar-Sirchang and lightened, then towed a bark up Bangkok river and discharged our petroleum. We then went up to Cebu, and on going there, we broke the wrought-iron neck of the starboard feed pump. No. 2 winch cylinder was patched, gipsy (new) wheel put on steering gear, No. 2 winch stop valve, new neck for feed pump, and bolt for l.p. shoe for top end on arrival at Singapore, where we remained over two days. The captain said the winch must be done now, as he would and could not go through the canal in the condition the winch was in, and besides, he said we cannot stop the winch with that broken stop valve, which on examination had the metal cracked where the brass seat fits in.

All went well until we got into the canal, when the starboard boiler check valve joint blew out; we went on with the port boiler, as we could not keep water in the starboard, and on the ship stopping at Ismalia, we worked all night, put a larger plate between outside plate of boiler and check valve to cover the hole in corroded plate. This was held until we got to Port Said, when being afraid it would not stand for any length of time, as there was salt oozing out of the red lead, and for the benefit of the ship, fearing it might blow out at sea, we had a job made of it by Mr. Dowree, of Port Said, who put a plate each side and riveted through, steel bolts securing the internal pipe, through the three thicknesses and through the check valve flange. This detained us two days, and we went on again only to have another mishap, which occurred at 5:52 A. M. on the 31st October, the cause being the breakage of the two top end bolts of the low-pressure engine, and the first and only notice we received was a heavy thud, and the engines stopped dead, the crank of the l. p. engine being near the top center. On examination below we found the top brass of crosshead atwist on pin, with its flange crushed somewhat, and the brass jammed between the forced up broken gland and connecting rod pin; the bottom brass had followed the keep, and was fast at an angle of about forty-five or sixty degrees to the starboard guide, and what we most particularly noticed were the two top end nuts with guard-rings, and the broken pieces of bolt all intact in the cap, so this proved we never had warning by the dropping out of nut off cap, with its piece of broken bolt. On further examination, we found on the top the l. p. cylinder-cover flange completely off cover, and most of the studs broken. The next job was to get one engine away, so the piston tail rod was swung, and the connecting rod disconnected and taken out. Richardsons', of Hartlepool, engines are somewhat awkward in having the slide chest covers all in one. After trying a false cover of Muntz's metal twice over the h. p. valve chest, I found it would not keep tight, and in the hurry at the time we resolved to cut away part of the cover for exhaust and joint the rest, which was accordingly done. By this time it was dark, and the captain was burning lights to attract steamers going our way, viz., towards Gibraltar. At last a steamer hove to, called the '*Vindalana*'; at the same time, after a deal of trouble, the h p engine was got away, but the force of the exhaust steam burst the canvas at the base of our wooden exhaust pipe, the hot water showered upon us, and the only way to get on deck was through the stoke hold, as the engine-room, too, below the cylinders, was full of steam; besides this, the steam was walking back and the water lowering out of our two boilers, and we had only cold to supply them with, by the engine-room donkey engine. Being influenced by the captain and my other two engineers, that if we could not manage to go on, we should have the above steamer to tow us, after steaming over twenty minutes, and seeing the state of engine-room, and steam going back, I consented, so we stopped the engine, and were taken in tow, and reached Algiers on 1st November, at 3 P. M.

Since we have been in here we have found the bottom stuffing box burst inside, and in taking the piston off in the shop it burst.—*Engineers' Gazette.*

[Where is the ship now, after all this?—EDS. ENGINEER.]

STEAM JACKETS.

THE steam jacket is as old as the days of Watt, and yet its action is not universally understood. This action forms part of the true theory of the steam engine which has yet to be enunciated. We find some engineers claiming that the economical value of the jacket is immense; others assert that it does no good. It is not to be lightly assumed that either party is wrong. No doubt each speaks from experience. By degrees it is being understood that the steam engine is a very peculiar machine, working with an exceptionally delicate fluid, which has nothing in common with a permanent gas save elasticity, and that very insignificant changes in the conditions under which it is made to do work bring about very important alterations in the sequence and even in the character of the phenomena going on within the cylinder. Thus, as Hirn has pointed out, it is quite possible that an alteration in the proportions of a cylinder may have as much effect as the presence or absence of a jacket. The old-fashioned idea that a jacket does good because it keeps the cylinder hot only traverses a portion of the ground. It leaves untouched the question why should keeping the cylinder hot do good? Much condensation goes on in jackets—that is, if they are efficient, and it has been urged with some force that if the steam condensed in the jacket had been passed directly into the cylinder, it would have done just as much good. This is not true, however, and we propose here to show in very few words why it cannot be true.

Let us first assume, to simplify matters, that there is no loss by radiation. We shall explain presently what the effect of radiation is. We shall further take the case of a single cylinder engine. No steam is admitted to the jacket, and the consumption of steam is, under the conditions of expansion and pressure, 20 lbs. per horse per hour. Of this 6 lbs. are lost by condensation. Now let us turn steam into the jacket. The consumption in the cylinder falls to 14 lbs. per horse per hour, and the condensation in the jacket is 2 lbs. per horse per hour. There is consequently a clear saving of 4 lbs. per horse per hour. To understand why, we must consider, first, what happens to steam in the cylinder, and secondly, what happens to steam in the jacket. We have seen that 6 lbs. per horse per hour are condensed in the unjacketed cylinder. About 5 lbs. of this will be condensed during the period of admission, and 1 lb. during the earlier portion of the expansion period, and it will be condensed simply because the metal of the cylinder is cool. But, as we have repeatedly explained, an engine cannot go on playing the part of a condenser. Once it is fairly at work, it must deliver as steam all the steam it receives. It is true that it may get steam at 200 lbs. pressure and discharge it at $1\frac{1}{2}$ lb. pressure, but it is steam all the same. It follows that if steam is condensed at the rate of 6 lbs. per horse per hour during one stroke, it will be re-evaporated at the same rate every stroke. The re-evaporation is the measure of the condensation. Let us now consider what is the work done by the boiler and furnace. The total steam supply is 20 lbs. per horse per hour. It may, under the conditions, be assumed that 14 lbs. would have done had there been no condensation. Thus, the boiler has had to evaporate 6 lbs. of water more than was necessary; and all this 6 lbs. was ultimately discharged as steam from the cylinder, although it was first condensed in the cylinder. It is clear that it was evaporated twice over, once in the boiler and a second time in the cylinder; this second evaporation taking place at the cost of the fuel used as much as though it had occurred in the boiler. A small portion of the loss is restored, because the second boiling away takes place to a limited extent while expansion is going on. If our readers will carry clearly in their minds the idea that a considerable quantity of water has to be converted into steam twice over, they will be in a position to understand why it is that a jacket may promote economy.

Next, let us suppose that steam is admitted to the jacket, and that the jacket is so efficient that there is no cylinder condensation—an impossible thing, but admissible as a hypothesis for the sake of argument—the steam condensed in the jacket amounts to 2 lbs. per horse per hour, and it leaves the engine as water, not as steam; therefore this is not boiled twice over. Two pounds condensed in the jacket therefore represent no more loss than 1 lb. condensed in the cylinder. It may be asked why re-evaporation does not take place in the jacket, and the answer is simply that re-evaporation cannot take place unless there is a fall in pressure; as there is no fall in the pressure, water would accumulate in the jacket, unless it was constantly drained off. Broadly speaking, then, each pound of steam condensed in a jacket represents a saving of 2 lbs. of steam condensed in the cylinder. This, then, in a nutshell, is the reason why steam-jacketing may be useful. The steam condensed in a jacket represents one operation done by the furnace; the steam condensed in the cylinder always represents two boiling operations.

It is necessary, however, to bear in mind that the condensation in the jacket is a source of loss. It is, no doubt, a very good thing to save 2 lbs. of steam by wasting 1 lb.; but it is waste all the same, and a little reflection will show that the conditions under which the jacket can be used with advantage are sometimes very delicate indeed. It is well known, for example, that a jacket on the low-pressure cylinder of a triple expansion engine usually represents a dead loss, and this comes about in the following way. We have said that all the steam which an engine receives must be discharged as steam, but this is true only with limitations. Every engine condenses steam: first, in the performance of work; secondly, as a result of radiation and conduction. The latter losses may indeed be very heavy; much heavier than is commonly believed. The last cylinder, then, of a triple engine, being unjacketed, would discharge water into the condenser, not perhaps in a tangible way, but in the form of mist. Most probably it would collect in drops on the cylinder walls, be swept off by the piston, and be blown into the condenser with the exhaust. This water only represents one boiling, and a certain loss of volume. If, now, we jacket the low-pressure cylinder, the drops of water will be re-converted into steam during the exhaust at the expense of the jacket steam, and we shall have two boilings instead of one for this much of the steam, and the steam so made will do no work, but go straight to the condenser. If, however, we jacket the high-pressure cylinder, we shall have, it is true, the work of evaporation done twice over on a part of the working fluid; but the steam resulting from the second boiling will do work in the intermediate cylinder. In the same way a jacket on the intermediate cylinder will produce steam able to do work in the low-pressure cylinder; but there the gain stops. In quadruple expansion engines, again, the first three cylinders may be jacketed, but not the last, and this is not theory. It will be found that it is practice and very sound practice too.—*London Engineer.*

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THE DESIGN AND CONSTRUCTION OF CHIMNEY SHAFTS.

Scaffolding—In erecting chimneys, especially large ones, it becomes a question of importance from a pecuniary point of view whether the shaft shall be erected by external or internal scaffolding, the cost of the former being considerable, whilst that of the latter is comparatively trifling. In some cases, in which the shaft is of an ornamental character, and where the cap and its moulding have considerable overhang and weight, it becomes a necessity to construct the shaft by an external scaffold, but where the shaft and cap are of plain design an internal scaffold can well be employed; in fact, the greater percentage of shafts over 100 ft. have been erected with internal scaffolds. On the other hand, experience has shown that, from an architectural point of view, the appearance of the shaft is much more satisfactory when it has been constructed from an external scaffold, as the joints are much better struck. With chimneys of from 250 ft. to 400 ft. in height, it becomes to a certain extent impracticable to use an outside scaffold. Any chimney having a flue of not less than 3 ft. diameter can be constructed with an internal scaffold. Whether an internal or external scaffold be used, it should be so built as to be entirely independent of the shaft; no pulleys should on any account be built into the shaft, so that any settlement which may take place shall be of a uniform character and not re-acted upon by the scaffold. The well-known Townsend shaft, Glasgow, by Bancroft, was built by an internal scaffold, which was constructed with continuous vertical uprights and bolted to bearers every 5 ft., the latter being built into the wall and carrying the staging. The chimney was struck by a gale of wind while the brickwork was green, which caused it to sway considerably; this brought the pressure of the whole pile on the scaffolding, which, being so constructed as not to yield to the pressure by settling down, consequently threw the chimney out of the perpendicular. Rankine, when designing the West Cumberland Hæmatite Iron Works chimney, used an internal scaffold, but took great care that the horizontal timbers or bearers for carrying the staging should be supported wholly by the brickwork, and not by vertical posts, as in the Townsend shaft, which suffered from the upper brickwork coming to bear upon the ends of the horizontal timbers and, through them, to the vertical, owing to the settlement of the lower part of the chimney. The internal scaffolding used in the construction of the Mechernich chimney was of the nature of a shaft, and was carried up some 30 feet in advance of the brickwork for the convenience of hauling up materials and moving up the bricklayers' scaffolding as the brickwork progressed. Inside this scaffold shaft or framing was the bricklayers' scaffolding, which was fixed to the scaffold shaft, and occupied about eight men in its erection for one hour per day. The materials were raised through the internal scaffolding in a bucket having a capacity of 17 cubic feet by a small locomotive engine which ran on a line of rails starting from the bottom of the shaft. When an internal scaffolding is arranged to carry a frame for supporting a drum over which the rope runs by which the materials are hauled to the summit, this frame should be moved to the opposite side of the shaft at each lifting as the work proceeds, so as to equalize the pressure of hauling on the shaft. The holes made in the masonry to carry the frame should be filled up immediately after the frame has been lifted. In America the usual practice is to use an external scaffold, but in the midland and northern counties of England an internal scaffold is commonly employed.

In constructing a chimney shaft the weather becomes a matter of very great importance. Severe frost is dangerous, and will almost certainly destroy new work (at least the external portions). Therefore under no circumstances should a shaft of any magnitude be constructed during the winter, notwithstanding what has latterly been written about bricklaying in frosty weather. The action of alternations of frost and thaw on brickwork and masonry in this damp climate is well known. If a shaft is too lofty to be constructed in a single season, when work is suspended for the winter the surface at the top should be carefully covered and roofed over, and on commencing operations the next spring a course or two of bricks should be removed. Experience has shown that when a chimney under construction is exposed to continuous storms of wind and rain from the same direction it is detrimental in the extreme, the action of the rain being to keep the mortar soft and yielding on the weather side. If construction be carried on while the joints are in such a condition the increasing weight of the superincumbent mass above will squeeze the soft and yielding joints closer together than those on the opposite side, the result being a deflected or bent shaft. This action has occurred in a number of cases, the most striking of which is the lofty shaft at Messrs. Storey's Works, Lancaster, where the shaft when at a considerable elevation canted in one direction 3ft. $10\frac{1}{2}$in., and had to be straightened by being cut back. The Townsend shaft of Glasgow took three years—*i. e.*, three seasons—to complete, operations commencing in June and finishing in October.

Progress and Rate of Building.—The question as to the rate at which a chimney shaft or any other high masonry structure should be constructed is one of vital importance, the laying down of any hard and fast rules being impossible on account of the varying conditions under which they are constructed. The slower a chimney is built within limits of reason and economy the better; for it must be borne in mind, that as the weight on the lower portion is constantly increasing, the liability of the slipping of the mass is very great if the mortar has not had proper time to set. The rate of progress which may be allowed depends in a great measure on the following conditions, viz.: the size of the shaft, the effect of the weather on the setting of the mortar, and the quality and proportions of the lime or cement used. If cement mortar be used the rate of building can be considerably increased, as it sets more rapidly than lime mortar, and is also not so much affected by moist weather. The taller a shaft the more care should be exercised in allowing the mortar to set. More shafts have failed from rapid building than from any other cause; the brickwork cracking, bulging and deflecting out of the perpendicular in consequence of the inability of the soft joints below to carry the superincumbent weight above. In constructing a large shaft it is the usual practice to build the foundation and pedestal during the first season, allowing the work to stand for the winter or six months, to consolidate and settle. At the expiration of this time the rest of the work is completed. The rate generally followed is from 2 ft. to 2 ft. 6 in. in a working day of ten hours; this varies according to the size and height of the shaft. With the shaft designed by Professor Rankine before mentioned, the rate of building was restricted by the specification to a a rate not exceeding 6 ft. vertical height per day. This seems rather high, considering that lime mortar was used. The chimney cracked immediately after the admission of the hot gases. A large shaft at Barrow-in-Furness was built at the rate of 2 ft. 3 in. per day, including foundations. A large shaft also, at the Dovercourt Cement Works, was built at the average rate of 1 ft. 6 in. per day, including foundations. The first shaft at Messrs. Gostling's Works, Northfleet, 227 ft. in height, was built in sixteen weeks of good weather; the upper part, however, collapsed before it was quite completed, resulting in six deaths. The average rate, including foundations, was 2 ft. 5 in. per working day. The cause of collapse was attributed to the mortar not setting. The usual rate adopted by the late Metropolitan Board of Works is about 10 ft. per week. The last 354 ft. of the circular stalk of the Mechernich shaft was built in 107 working days, and during that time the weather was very unfavorable. The daily rise was from 1.96 to 6.56 ft., according to the thickness of the walls and the state of the weather, no working day being lost.—*Industries.*

(*Concluded.*)

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TOO MUCH BEER.

THE peculiar methods which obtain in England among workingmen are thus shown by an American superintendent who recently returned from that country. He says that he can hire all the laboring men he requires at any time in London for fifteen shillings per week, and that applicants for work are more numerous then the demand; that the regular labor union price for skilled mechanics is but nine pence an hour, about eighteen cents of American money. He adds:

"One of the chief reasons why the working classes fail to get on over there is because they pay too much money for beer, and do not work steadily enough; that between American and English laborers, so far as activity and neat work is concerned, there is really no comparison.

"In London the men I employed came at 6 o'clock in the morning, but did not attempt to do anything; they just waited around inspecting things until 7 o'clock, when they left for breakfast, and failed to put in an appearance until an hour later. At 8 o'clock work really began, and continued without intermission for two hours, or until 10 o'clock, when I was surprised to hear the shrill notes of a whistle, and to see all my force of laborers knock off and go to drinking beer, which pleasant recreation consumed just fifteen minutes—the time allowed in that country for that purpose. At 10:15 o'clock work was resumed, and went on steadily enough until 12 o'clock noon, when the whistle sounded again, and five minutes more were permitted the men to drink more beer. At five minutes past 12 o'clock the men went on with their work and continued until 1 o'clock, when dinner was announced, the full hour from that time to 2 P. M. being allowed for the meal. At 2 o'clock sharp all hands were again at work and were kept at it until 3:30 o'clock, when again all hands are 'piped for beer' and a fifteen minutes' rest, when, returning to their places, they work until 5 o'clock. At this time five minutes more is allowed for an indulgence in the refreshing beverage, when work is again resumed and continued until 6 o'clock, when it ceases for the day, to be followed on the next day by the same routine.

"The breakfast of the laborers in London consists of bread and beer; dinner of a chop, which is purchased at a butcher's and brought to some place where it is cooked for the men and washed down with huge draughts of the panacea of all ills in that country, strong beer." No man ever got rich by drinking beer.

IT is commonly remarked that the man who actually invents a machine does not ordinarily enjoy the fruits of his genius. While the public knows of this, that or the other valuable invention, by the name given it, it is quite frequently the case that the title by which the machine or method has become famous is not the name of its real inventor, or, if it should happen to be such, it is rare that further investigation shows that the man who created it is receiving the full share of the profits resultant from its sale and use. One reason for this is that inventors are proverbially poor business men, and are apt to part with their creations for a mere mess of pottage. To invent is one thing, to place the invention on the market to practically test its merits and determine its value commercially quite another. The former requires a peculiar kind of brain, the latter both brains and money. It is not always to the disparagement of the owners and manufacturers that the profits from the invention they sell go to them rather than to the inventor himself. Thousands of patents are granted, and by the medium of the capitalist are introduced on the market only to prove total failures, to hundreds which are found of real value and achieve success. To those who have the courage and energy and means to handle a successful invention, as much credit is due as to him who created it. Nevertheless, the story of those who are really entitled to the profit and glory accruing from the success of a machine, and who have, by mischance or misfortune, or by lack of means to fight, been deprived of their just deserts, is always a sad one. The tide in the affairs of men which, taken at the flood, leads on to fortune has ebbed away from them, and they are stranded, while others less worthy perhaps, sail out upon it to a golden harbor.—*Northwestern Miller.*

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THE embodiment in designs of the various opinions held by builders with regard to form of hull in relation to power and speed, produces marked differences in the expenditure of power and general efficiency, when the object aimed at is the same. British builders as a rule adopt comparatively full bow lines, with sections more or less of the U-form. In many French built boats the waterlines at the extremities are comparatively full. German builders, on the other hand, seem to believe in extreme fineness of entrance, and to secure this feature have in the majority of cases placed the greatest section abaft the middle of the length, giving to the boat a long fore-body, with a relatively full after-body. The adoption of such a form tends to reduce the proportions of the bow wave created when running, and to remove the crest farther aft along the side, but against this crew space is reduced and comfort at sea sacrificed. The difference in fullness between the fore and after bodies is greatly exaggerated when the boat is running, as an alteration of trim then takes place, the bow rising above and the stern falling below the original level. In relation to resistance, the policy of adopting an after-body full in relation to the fore-body is a doubtful one. Mr. Froude—than whom no better authority can be quoted—has distinctly stated that fish-shaped bodies, towed with the blunt end foremost, experience a less resistance than when towed from the fine end. Applying this statement to the type of vessel under consideration, then those which attain extreme speeds, with relatively full runs, do so with an undue expenditure of power; and it has also been proved that excessive fineness of fore-body is not a desirable quality at sea.—*Industries.*

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A JOURNEY round the world has just been made by an attache of a daily paper, and it shows that with the present facilities it can be done in about 73 days, detentions and all. This is a little over 14 miles an hour, and considering the long sea voyages, is not bad time.

SOMETIME ago the United States Hydrographic Office developed a new plan for studying ocean currents. The officers in charge had observed that a good many empty bottles are dumped over every day from passenger ships, while only an occasional bottle is thrown from a sailing vessel; but every ship has empty bottles to throw away, because seafaring folks are fond of various sorts of stuff usually stowed in bottles. To make use of them the hydrographic officers proposed that a slip of paper be put in the bottle, which should then be set adrift. The slip was a blank, as follows:

Thrown overboard from
.........................ship...... ....
Position { Lat.......................
{ Long................ ...
Date................ ......
Found at
....
Position { Lat..... .. ..
{ Long............ .....
Date. . ...

Directions.—The finder of this paper will please fill out the blanks and forward the same to the nearest United States Consul, or to the United States Hydrographic Office, Washington, D. C., U. S. A.

Captains of ships took kindly to the idea, and the old bottles have been sowed with liberal hand on the oceans of the earth. The returns began coming in in increasing numbers.

The chief hydrographer is now arranging the slips, and will print a pamphlet on the subject. It is expected that enough will be brought in to form the basis for a valuable study of ocean currents.

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THIS is from the *North-Western Miller:* It is the custom of most publications to inflict upon their readers about this time of the year a prospectus setting forth what they expect to do for those who subscribe. We have not done this, and offer the above in lieu of such a statement. We have nothing to promise except that we will give those who read this journal the best work we are capable of, always tell them what we believe to be true, give them our opinions unvarnished, to be taken for what they are worth: that we will stand by the best element in the trade, the progressive element and the element that is sincere and straightforward, and that we will be the everlasting foe to all quacks, humbugs, sharks, wolves and robbers, that we will clamor from now until doomsday for less delay in transit, a better shipping document, and a union among millers. Finally that we will do what we do with all our might and with both feet.

Well, neighbor, you seem to have got it all in just the same.

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IT would be interesting to know what manner of men are always for tinkering the patent laws. There doubtless never was anything made by man that could not be improved by some other man, but it is good sometimes to let well enough alone, and it is difficult to see wherein the present patent laws could be improved.

Among a number of bills relating to patents, one proposes to change the lifetime of them from seventeen to seven years, and another provides that any patent hereafter issued may be canceled by special act and the payment to the inventor of not less than $50,000 nor more than $100,000, with authority for Congress to grant a further allowance to the inventor of the amount expended by him in perfecting his invention.

We propose a bill which provides that the income of any person tinkering with the patent laws shall be permanently cut off, and he be confined in a lunatic asylum for life.

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BEFORE blaming the gas companies and the meters for exorbitant bills just examine the burners. A common illuminating gas burner has a tip on it that will enable not more than 5′ or 10′ of gas to be burned per hour. Take the tip off, and you will have a flame a foot high. Without the tip you use 50 times the amount of gas and have no better light.

TRADE NOTES.

Capt. Jack Haynes, the engineer in charge of the elevator engine at the Fagin Building, St. Louis, is one hundred and two years old. It is time he took a rest.

* * *

C. W. LeCount, South Norwalk, Conn., has issued a new pattern of his well-known cribbage board, which is indispensable to all students and lovers of the game. Address him for particulars.

* * *

The horse power of the '*Baltimore's*' engines, which has been so long a matter, first of popular speculation, then of official test, and finally of precise calculation, has at length been fully determined. It amounts to 10,064 and a fraction.

* * *

The keel of what will be the largest sailing vessel in the world has just been laid in one of the shipyards of the Clyde. She will be 9,600 tons, over 350 feet long, and will carry on her five masts a spread of canvas that would capsize Noah's ark.

* * *

The Railroad, Telegraph and Steamship Builders' Directory for 1890 is a useful compilation of business firms in the lines named all over the country, and is indispensable to buyers and sellers of goods for these trades. It is published at 18 Cortlandt street, New York.

* * *

A deposit of ozokerite covering about five thousand acres has been discovered in Utah. This is the second deposit of the curious mineral ever found. Ozokerite is a black, wax-like substance, which, being refined by paraffine, produces celnsin. In addition to being valuable in the manuacture of rubber goods and fine candles, it is one of the best insulating materials known.

* * *

A Montreal man has been condemned to pay the sum of $1 as damages for having called upon a person in a factory with a view to collecting a debt. The court held that the domicile of the debtor is the proper place at which to demand money that is owing. It further declared that to ask on the street for money that is due constitutes an assault. It would appear that the average debtor has far more protection than the creditor.—*Toronto Mail.*

* * *

It is stated that the firm of Armstrong, gunmakers, intend to establish an immense shipyard here, and bid, through Americans interested in the enterprise, for the construction of the ironclad vessels which it is proposed to build for the United States navy. The claim is made by the Armstrongs that they can profitably compete with the American shipbuilders on their own ground and easily command the American influence necessary to secure contracts.

* * *

The projectors of foreign syndicates have turned their eyes upon the lake steamer lines out of Buffalo. A syndicate, with headquarters in New York as nearly as can be ascertained, is said to have closed a bargain for all the vessels owned by the Red Stack Line, and proposes to get all the others that it can.

The first installment of the money was to have been turned over Jan. 21, but was not. The seven vessels owned by the Red Stack Line are valued at $737,000.

* * *

The Carbon Iron Works, Pittsburg, are making steel by the direct process. Rhode Island graphite was formerly used to absorb the impurities of the iron ore. The graphite was a success, but the freight on it amounted to a considerable figure, and the company looked around for something with which to replace it. They experimented with coke and soon found that it would answer all purposes when treated with whitewash. When coke was broken into small pieces and soaked in whitewash all the impurities of the ore were fused the oxygen of the iron joined with the carbon of the coke passing off as carbonic acid gas, leaving the impurities in such a shape that they could be easily eliminated.

By this means the blast furnaces are done away with, and a great deal of expense avoided. The coke has now been in use for over a year, and as a result the Carbon Works are turning out some of the finest bridge plates made in the United States, and steel is being produced which is very low in phosphorus.

* * *

Secretary of the Navy Tracy's attention has been called to a remarkable letter written to a California newspaper by Commander J. B. Coghlan, commanding the '*Mohican*,' U. S. N., on the Pacific station, in which the Commander makes a bitter attack on the administration of the Mare Island Navy Yard, and especially the steam engineering department in that yard. He also criticises the Bureau of Steam Engineering and the Engineer Corps in the Navy in general. Commander Coghlan accuses the engineers of incompetency, and alleges that the engineers of the '*Iroquois*' became drunk every time they got steam up in the boilers. From the engineers he turns his attention to the line officers, the surgeons, and the paymasters. He has something to say about each corps, and sums up as follows: "Each line officer thinks he should command the Navy, each engineer thinks he should, too; each paymaster ditto, and each doctor the same, and the ordinary business of the Navy is running to the dogs." It is expected that Secretary Tracy will refer this letter to the Judge Advocate General.

* * *

Among recent inventions is a new process of evaporation by which perfectly pure distilled water may be had at a reasonable cost. This process is known by the name of its inventor, Mr. H. T. Yaryan, of Toledo. The fluid to be treated is fed through tubes, while the heat is applied around them by the live steam generated in the usual manner. These tubes are arranged in a series of three, four, five, or six, or even eight cylinders connected with each other, through which the fluid circulates, surrounded, as above indicated, by live steam, which gives up nearly all its heat before it is permitted to escape. The details are simple, the tubes and condensation chambers are easily flushed and cleaned by live steam, and the work done by each set is called an "effect." Thus a battery of three cylinders produces a triple effect, one of five a quintuple effect, and so on. The machinery for a quintuple effect involving five cylinders and the necessary tubing, utilizes more heat, or in other words requires less fuel, and is correspondingly economical. Although it has been in use less than three years, it has gone all over the world.

* * *

The *Industrial Journal*, of Bangor, Me., says this of the Maritime Exhibition at Boston:

"The dull thud with which the Maritime Exhibition has dropped is a result to be regretted; that an enterprise so important, and of such vital interest to our country and her industries should come to such a deplorable end, for want of support. Yet, such is the case, and to-day the proprietors (nominally) and managers of the exhibition are $50,000 in debt. They have been compelled to go into insolvency, and have been placed under arrest, pending process of law. The exhibition was a grand success, except financially, and that's what's the matter. The expense of running the show was enormous. Another misfortune was, that much that was advertised never appeared in the building, not so much the fault of the management as a curious series of disappointments."

[The reason for this state of things was the wholly incapable management. The result proves this without any argument. Bluffing and puffing does not make a manager, neither does the adulation of penny-a-liners, like the writer above quoted, who is forever giving "notices" to some one.]

* * *

The American Yacht Club proposes to select a day during the coming season for squadron evolutions, and the owners of steam yachts of recognized yacht clubs will be invited to join in a drill of steam yachts in steam fleet tactics. Prizes will be awarded to the captain, engineer, and members of the crew of the yacht considered to be handled best. This is a new idea, originated by George W. Hall, Chairman of the American Yacht Club's Regatta Committee. It will no doubt be an extremely interesting exhibition and will help to make the club's season enjoyable. It is expected that there will be a steam yacht race given by the club this year, although such a race is difficult to arrange, because the steamers are apt to be cruising, and besides, owners are backward about driving their engines as they would have to do in a race. Steam yachts require special preparation for a race and an overhauling after it. The officers of the American Yacht Club, elected last week, were: Commodore, W. H. Starbuck, steam yacht Tillie; Vice-Commodore, C. H. Osgood, steam yacht Narwahl; Rear Commodore, F. R. Lawrence, schooner yacht Siren; Secretary, H. A. Taylor; Treasurer, George W. Hall; Fleet Surgeon, C. I. Pardee; Measurer, Charles H. Haswell; Trustees: J. P. Kennedy, H. A. Taylor, F. R. Lawrence, Joseph Stickney, Washington E. Connor, Maturin Ballon, and George W. Hall; Regatta Committee: G. W. Hall, T. L. Scovill, W. S. Alley, Ezra S. Connor, aud Howard Wainwright.

* * *

A company was formed in Wall street recently for the construction of a two-track railway tunnel under the East River, between the foot of Broadway, Brooklyn, and Broome street, New York. The company is to be known as the East River Railway Company. On the 17th, the company, at its office in the Mills building, entered into a contract with the Henning Gravity Tunnel Company by which it secured the right to use the patents and methods of the Heuning company for rapid transit. The railway company also contracted to build a tunnel upon the Henning principle in two years. The company was incorporated with a capital of $100,000. Among the incorporators are Benjamin S. Henning, H. C. Helmer, C. H. Odell, Otto Andreal, Jr., Alexander Curtis, and John C. O'Brien, of New York, and T. A. Patterson, of Brooklyn, and C. W. Smith, of Chicago. It has organized by electing Benjamin S. Henning, President, and George S. Morrison, Consulting Engineer. Major B. S. Henning, in regard to his system, said: "The system consists simply of a tunnel with sharp inclines at each end. A car or train descending the incline at one end gets momentum enough to carry it across the level portion of the tunnel and to a point on the opposite incline, where it connects automatically with a cable which carries it up to the station. The speed and time required for the crossing are regulated, of course, by the depth of the tunnel and the steepness of the incline. We can make the trip under the river in a minute. My system is patented. We start with a small capital, because we may find the bed of the river such that a tunnel there would be impossible. We shall first bore through from four to ten test holes at a depth of 150 feet and see what the bed of the river is constructed of. We have lots of backing, and we are going to succeed."

* * *

Tugboat captains, who are alert in answering signals of distress from vessels, and who have to "dicker" with the owner of the relieved vessel as to the compensation to be allowed them, will read with pleasure a decision handed down Jan. 21 by Judge Addison Brown, in the United States Circuit Court, in the case of the owners of the tug '*Joseph Loughlin*' against the owners of the ferryboat '*James Ramsay*' of the College Point ferry. Last July the ferryboat ran aground off College Point, struck a hidden rock, and was badly damaged. The tug answered her signals, pulled her into deep water, and staid by her all day towing her on her trips. After the trouble was over the question of compensation came up, and, as the owners of the '*Ramsay*' demurred to the demands of the tug's owners, the latter brought suit in the United States Court, as much to get a judicial decision as to the value of such services in time of danger as to secure the amount demanded. In concluding his opinion, Judge Brown makes these pointed remarks:

"It is of great importance in all cases of danger or apparent danger that when a call for help is made other boats able to aid should repair instantly to the place of danger, and, though the service finally found necessary may be comparatively small, the compensation allowed should be so far beyond the ordinary rates for daily work and so liberal that there should never be the slightest hesitation in dropping ordinary business and repairing to the scene of danger. The rate of compensation must be such as to secure always the promptest assistance, and upon the above consideration I award to the libelant (the tug owner) $300 and costs, two-thirds of the award to the owners of the tug, and of the remaining one-third $25 to go to the captain, and the rest to be divided among the crew."

CLUB RATES FOR 1890.

In former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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Those who are willing to aid our enterprise to the extent of soliciting their friends to come in, can write the names on a separate sheet and send them with the money. Send an express company's receipt or postal notes in preference to postal orders. Be particular and have all names and addresses correct.

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	Publication Price per year.	With The Engineer.
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American Machinist.........	2.50	4.20
London Engineer...........	10.00	11.00
Engineers' Gazette, London	1.50	3.50
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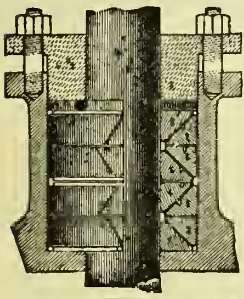

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January 23, 1890.

SEALED PROPOSALS will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock P. M., on the 28th day of February, 1890, for all the labor and materials required to complete the approaches to the U. S. Post Office, Court House, etc., building at

WICHITA, KANSAS,

in accordance with the drawing and specification, copies of which may be had on application at this office or the office of the Superintendent.

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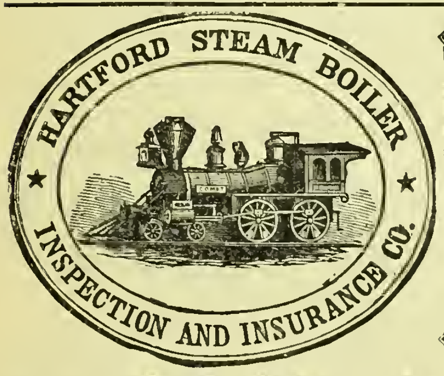

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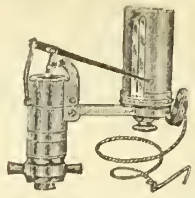

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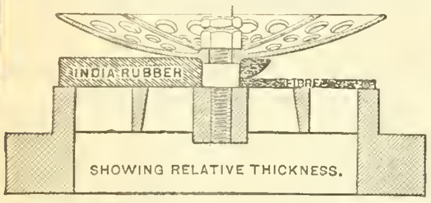

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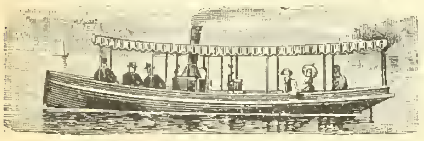

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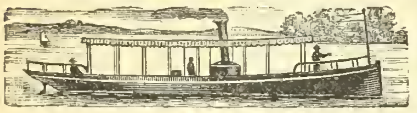

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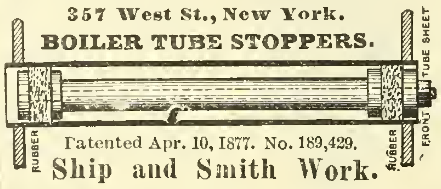

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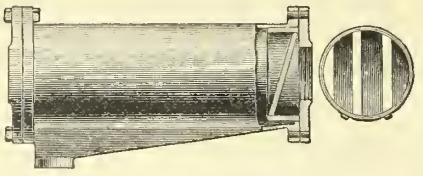

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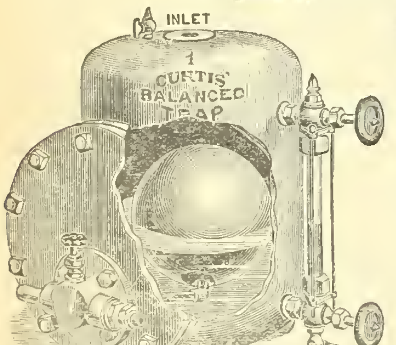

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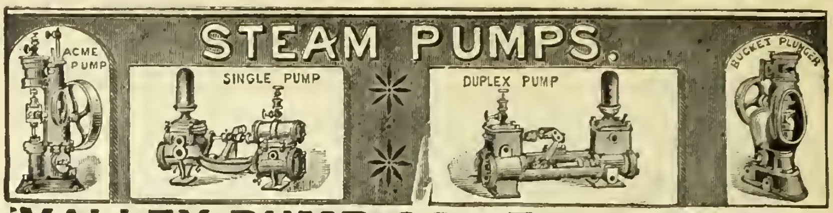

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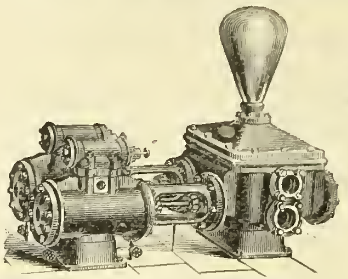

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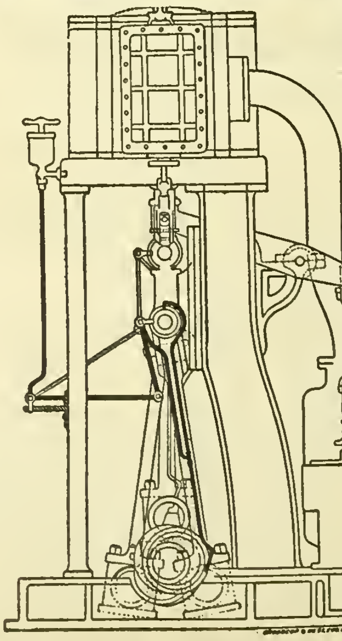

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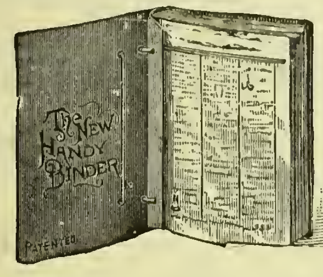

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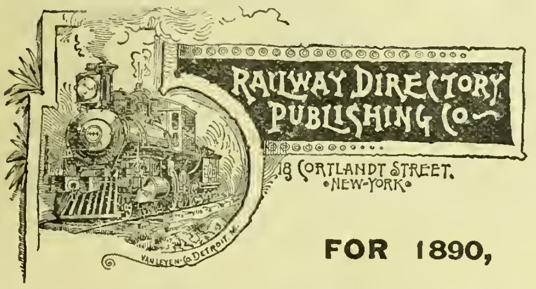
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COLGAN M'F'G Co., 234 West St. NEW YORK, May 21, 1888.

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HENRY LAWRENCE, Chief Engineer People's Line.

OLD DOMINION STEAMSHIP COMPANY.
NEW YORK, May 1st, 1883.

GENTS:—In answer to your inquiry as to how I liked your Lubricating Balls for lubricating the valves and cylinders of our compound and other engines, I am pleased to say, after a trial of five months on the Steamship "Roanoke," and two months each of the Steamships "Guyandotte," "Breakwater," and "Richmond," that it has given entire satisfaction. We use two Balls an hour in the large engines, developing 1,400 horse power, and one Ball per hour in the small engines, developing 500 horse power. We find the valve and cylinder surfaces wearing much smoother and the friction greatly reduced. The surface condensers and boilers are entirely free from the filthy grease that collected in them when we used Cylinder Oil. I take great pleasure in recommending your Lubricating Balls to all parties who want a good lubricator for their valves and cylinders without having the filthy grease collect in their condensers and boilers. Very respectfully, GEORGE V. SLOAT,
Supt. Engineer Old Dominion Steamship Co.,
Pier 26 (New No.), North River.

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GENTLEMEN:—In reference to your Patent Lubricating Balls, I have used them on board the steam Yacht "Stranger," and found them to be all you claimed for them. I have used the best cylinder oils in the market, but owing to the steam being superheated at 5 lbs. pressure, I had a good deal of trouble to keep the valve face in order till I commenced to use the Balls, after which I had no further use for oil, and also my boilers are free from grease and dirt, and I may state they are cheaper than oil in direct cost. I take pleasure in recommending them to any person requiring a good internal lubricant. Yours truly,
JOHN REDMOND,
NEW YORK, Dec. 2[illegible]th, 18[illegible]6. Chief Engineer Steam Yacht "Stranger."

These are only a few out of many similar which we shall be pleased to send on application.

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NEWPORT, R. I. June 11th, 18[illegible]6.

GENTLEMEN:—After having used your Lubricating Balls for three months, unsolicited and as an act of justice to you, I take great pleasure in stating they have worked to my entire satisfaction.

I find the wearing surfaces of the valve and cylinder very much improved, consequently the friction must be and is greatly reduced.

The first month I used two balls per hour; I gradually reduced the expenditure to one ball per hour.

They work equally as well, and I am using them in the cylinder of the circulating engine running at high speed.

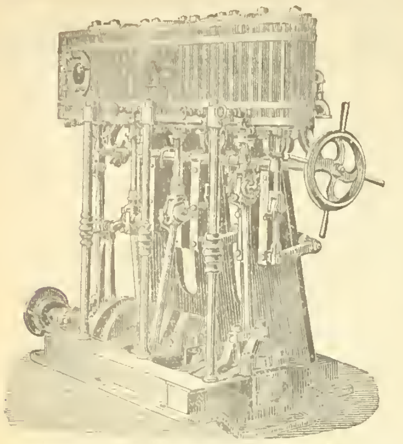
[illegible] continue the use of your Lubricating Balls, because I have found them to be superior to any lubricant I have used in the cylinder, so the most economical.

I will also state the condition of the boiler now is so much improved that it is a pleasure for me to go in it, while such was not the case before I used your Lubricating Balls; consequently, they are all you claim for them.

Very respectfully,
M. T. CHEVERS,
Chief Engineer, U. S. R. M.

TO COLGAN MANUFACTURING CO.,
No. 2[illegible]4 West, cor. Beach St., New York, N. Y.

THIS PAPER CIRCULATES ALL OVER THE UNITED STATES.



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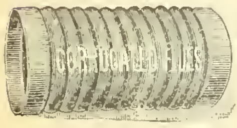

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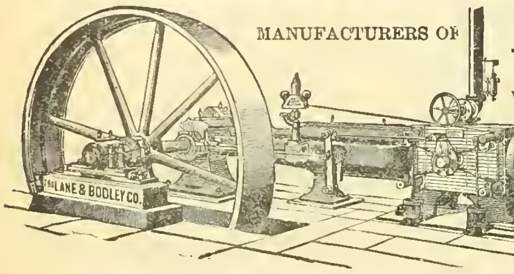
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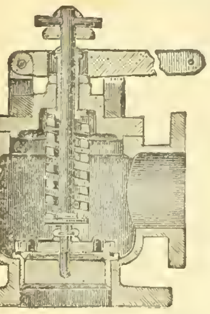

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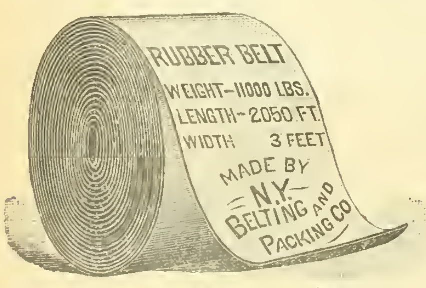

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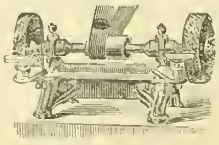

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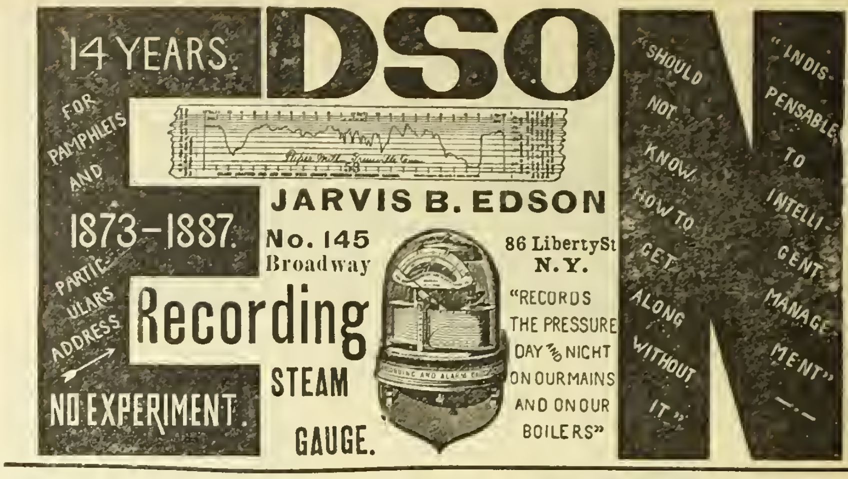
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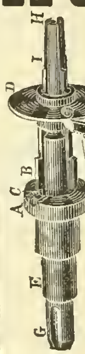

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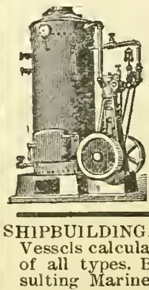

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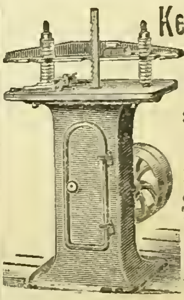

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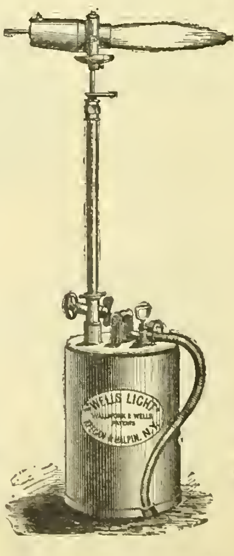

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NEW YORK

New Series, 1883, 1888. Vol. XIX. No. 4.
Ninth Year of Publication.
STEAM ENGINEERING, APPLIED

$2.00 per Annum. - Single Copies, 8 Cents.
February 15, 1890.
MECHANICS, AND THE ALLIED ARTS.

IMPROVED STEAM PUMP.

BY THE VALLEY PUMP CO., EASTHAMPTON, MASS.

The Valley Pump Co., Easthampton, Mass., have made an improvement in the valve gear of duplex pumps which is shown herewith.

It will be noticed that instead of the link commonly employed for moving the steam valves in duplex pumps, a straight rod is substituted in this pump without any joints. On the rod are two collars, held in place by set screws which can be adjusted to lengthen or shorten the strokes; between them is a spool loose on the rod, which is moved by the crank of the rock shaft until it comes in contact with one of the collars, when the valve is carried along and the motion reversed. It is claimed that this arrangement is more durable than that employing links, as the point made by the crank-pin and flanges of the spool are the only parts to wear; the surfaces being large and the spool having a rotary motion, the wear is reduced to a minimum. The Valley Pump Co., Easthampton, Mass., carry at their works a full line of these pumps in stock, from 3″ to 14″ diameter of steam cylinders.

◆

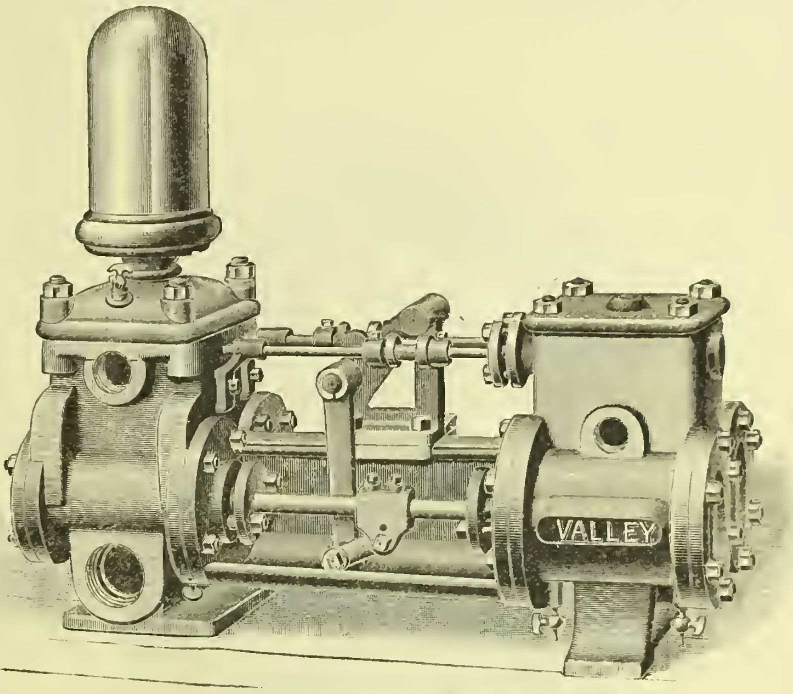
A curious case recently tried in New Jersey was that of a concern which sued two former employees for incapacity, laying damages at $50,000. The owners claimed that the defendants entered their employment in 1883 as superintendent and manager respectively. They were to give their time, labor, and skill for three years and two months at a salary of $3,000 each per year, and were to receive ten per cent. of the net profits of the business. The plaintiffs claimed that the defendants did not fulfill their contract, that they willfully neglected and unskillfully managed the business, and that the workmanship was defective, thereby injuring the business of the plaintiffs to the amount of $50,000. That after making the agreement the defendants changed the way in which the business had been conducted. They sold a large quantity of goods, which was pronounced a failure, and was sent back to the firm.

The company lost the suit.

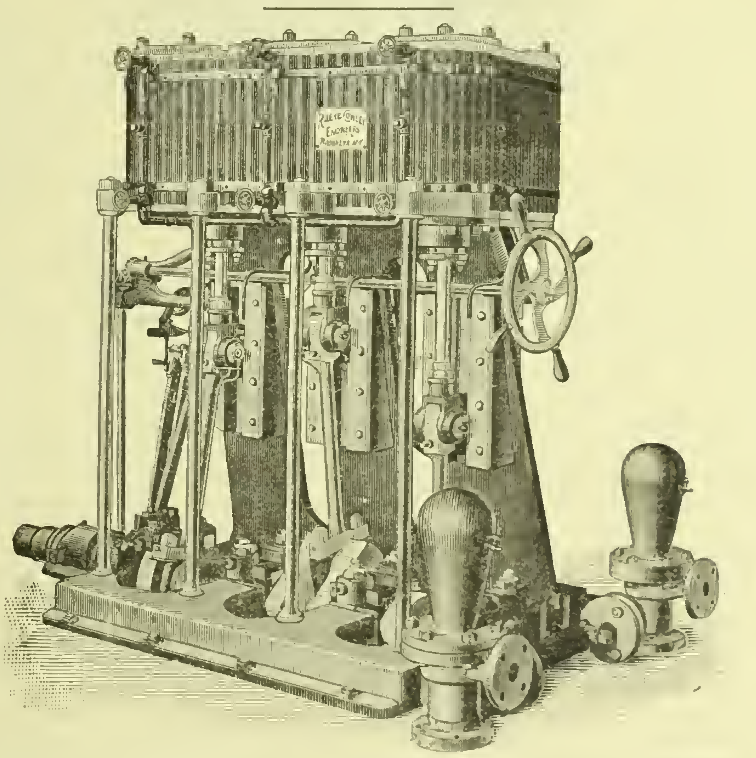
◆

At Tillamook Rock, Ore., the sea waves were so high lately that the water came down the chimney of the boiler house of the fog siren in torrents, and poured out through the tubes of the boiler. The chimney is about 130 feet above sea level. The spray entered the cowl of the chimney over the lamp, which is 150 feet above sea level, and ran in streams to the bottom.

This thing of milling out the grooves in twist drills, amounting to more than half their section, has always seemed an absurdity. A good many years ago, ten or more, a company in New York began to make forged drills, and succeeded. Succeeded so well, at any rate, as to cause the enterprise to be bought up by some of the leading makers of milled drills. The forging process is not only to save metal, but to produce better tools, and we recommend our friends to call for forged drills when they can be procured.—*Industry.*



IMPROVED STEAM PUMP.



TRIPLE-CYLINDER EXPANSION ENGINE BY RILEY AND COWLEY.

We have always understood that these forged drills warped very badly in hardening. Many concerns have started making gouged twist drills in the last few years.

TRIPLE-CYLINDER EXPANSION ENGINE BY RILEY AND COWLEY.

The engraving represents a triple-cylinder expansion engine with cylinders 4″, 6½″, and 10″×8″, built by Riley & Cowley, South Brooklyn, N. Y., which has been put into many steam launches and yachts where it has given excellent satisfaction. As will be seen the engines are easily accessible all round, and occupy as little room as possible. The valves are of the piston type on high pressure and intermediate cylinders, with slide valves on the low pressure. The high pressure cylinder is forward. There are no links, and but three eccentrics for the three cylinders. These eccentrics are close together on the rear end of the shaft; one operates the low pressure valve directly, the motion from the other two eccentrics is carried by rock shafts to their respective cylinders. These three eccentrics work from a sleeve that is free to rotate upon the shaft. In the sleeve a spiral groove is cut, and in the shaft a straight keyway is provided, attached to a second short sleeve that works outside of the other one, that is moved by a rack and pinion so as to turn the eccentrics one way or the other, reversing the engine without the use of link motion. The estimated horse-power is 75, with 450 revolutions and a steam pressure of 250 pounds to the square inch. There are independent air, circulating, and feed pumps. These engines are made in the best manner and of the best material and being entirely self-contained, can be hoisted out of a vessel and stored away under shelter in winter if desired.

◆

There is one rule which ought to be taught in every school in the United States, and that is, never lift a wire off the ground. As long it is on the ground it is harmless, no matter what pressure may be upon it. The moment it leaves the ground it may be dangerous. If it is in the way of traffic, you can safely pull it across the street with your foot, then put your foot on it and hold it to the ground, and it cannot hurt you, but do not lift it. Never touch a wire tied on a pole. It may not be dangerous, but it is like an unloaded gun, it may kill you.—*Electric Power.*

◆

The Lords of the English Admiralty have just officially reprimanded an engineer cadet, who when asked "How would you proceed to get steam up? replied, "Tighten your funnel-stays and regulate your funnel draught, then look up and say, 'I am ready to go home if the boiler front comes out.'"

BOILER MAKING. No. 33.

BY JOHN COOK.

ALL persons engaged in the use of steam should know what the bursting pressure of the boiler shell is. There are rules published, but they are useless to a great many, as they are mostly in algebraic symbols and formulæ, which only a few can understand. Most practical men would like to see the rules in plain figures, or have the examples in plain figures, so that the dullest of them can see how it is worked. A rule to find the bursting pressure is to multiply the strength of the iron in pounds per square inch, by twice the thickness of the plate in inches, and divide by the diameter of the shell. Now, for a 36 inch shell, having a tensile strength of 45,000 lbs., and $\frac{1}{4}''$ thick, the example would be:

$$45{,}000 \times .50 \div 36.$$

This gives 625 lbs. as the bursting pressure if the joints were as strong as solid plate, but in single riveted joints, sixty-five per cent. is all that is allowed, therefore we say that $625 \times .65 = 406\frac{1}{4}$ lbs. as the bursting pressure per square inch under steam.

Domes and drums, in fact all heads of boilers, should be braced thoroughly to withstand these pressures. I wonder if engineers who have a trick of wedging the lever of the safety-valve down, know how much force they have confined in the boiler? And boiler-makers as well, who put only five or six $\frac{3}{4}$ braces in a dome of some size. I don't believe they know what, or how much pressure they will stand.

To have the head of the boiler equal in strength to the shell, the rule is to multiply the square root of the radius (half the diameter) by the thickness of iron in the shell in inches. The radius of 36″ is 18″ and the square root of 18 is 4.24, and the example would read:

$$4.24 \times .25 = 1.0600.$$

We need, therefore, a head 1″ thick to stand as much pressure as the shell; that is 1″ wrought-iron without being braced.

All holes should be fair, and rivets driven with care; in fact, in building boilers the greatest care should be taken, for what a magazine of destruction a boiler is in careless hands! Most mechanical writers say that machine-driven rivets are best in boiler work. I can't see it, for when the rivet is finished it is still hot—red-hot, and has yet to shrink, and in driving another rivet alongside of it, will shove the sheets over, or out. When the hammer-driven rivet is finished it is done shrinking. Of course a rivet can be hammered on till it is crystallized, but there is no need of that. If the rivet is driven judiciously by hand it makes the best and tightest work. This is easily proven any day. Take a boiler that has been riveted by hand, and very few of the rivets will leak when testing. Take one that has been machine riveted, and over half of the rivets will leak, and leak badly.

The very best of work can be made in driving 250 to 300 rivets per day on straight jobs, such as the shells of stationary and other boilers. Some may think that to drive even that number is too much, but it is easier than driving 150 and keep on the rivet six or seven times around. Four times around is quite sufficient on $\frac{5}{8}$ or $\frac{3}{4}$ rivets, but every blow must tell, and must be put in the right place. It is labor thrown away to keep too long on a rivet. There can be a great many more rivets driven by machinery than by hand, and I think even they could be improved if they were gone over the second time. That is, when the seam is riveted up give each rivet a couple of blows over again; that would tighten up those rivets which had got loose. I would take a little more time, but I am positive that this time would be more than balanced in calking the rivets when testing.

I think it must have been quantity, not quality, that writers have been thinking of when commending machine-riveting over hand-driven rivets.

In condemning machine-rivets I mean those done by the steam riveters. As there are only two blows struck on the rivet in some places it leaves the rivet too hot as before stated; if a little more time was taken with them, and a small stream of water allowed to run on the dies to keep them cool and help cool the rivet before the last blow was struck, the rivets would be tighter and better.

(To be continued.)

JOHN H. GALWEY, NATIONAL PRESIDENT M. E. B. A.

WE take pleasure in presenting our readers with a portrait of Bro. John H. Galwey, the first salaried president of the Marine Engineers' Beneficial Association. President Galwey was born in Detroit, Mich., on August 7, 1848, and is now forty-one years of age. He has been fifteen years in the M. E. B. A., and has held every office within its gift. He has been a marine engineer for eighteen years, and for the last ten years was chief engineer of the '*Alaska*,' formerly a fast sidewheel boat running between Detroit and Sandusky, O. This vessel was burned at her dock in May last. The company are building a new vessel which Bro. Galwey was to have, but his election to the presidency will cause him to resign.

Bro. Galwey's Association, No. 3, of Detroit, presented him last year with a gold chain and bric-a-brac attachment as a mark of their esteem for the man personally, and all who have ever come in contact with him will say that no better choice could have been made for the interests of the Order at large. Bro. Galwey will fill the position in all respects, and though he did not seek the office, and voted against a salaried president, as instructed by his association, he will devote all his energies to strengthening and adding to the Order. May his reign be peaceful and prosperous.

THIS almost incredible statement regarding English war vessels is taken from a foreign paper: "Besides their structural weakness they are subject to a serious source of danger from the fact that for the sake of lightness, they are built without the protection of double bottoms, while the moving parts of the engines are placed so low down in the hold that there is insufficient clearance allowed between them and the keel plates. Should, therefore, the eccentric rod break (as one did under trial at Devonport), or some obstruction find its way beneath the cranks, the probability is that the hammering of the one or the pressure produced by the other would knock a hole through the thin bottom plating."

THIS is rather a remarkable example of careless writing. It occurs in a letter to a railway journal. Speaking of English cars, it says:

> "The compartments have certain advantages not attainable in our cars. The doors at the sides afford a means of ingress and egress that allows the passengers more freedom than we attain. I noticed that, as I stepped from the door to the platform and walked toward the forward end of the train, before I had reached half the distance the passengers leaving the cars were all out, and the newcomers seated in their places."

Lower down the same writer says:

> "The next stopping-place was Crewe, where they took on ten more cars, making a train of thirty-two cars. I did not see that the passengers got out of the coaches any more rapidly than they would from the cars of the Boston & Albany or Old Colony railroads."

Again upon another subject the correspondent says:

> "Every man in the railroad employ is gentlemanly, not only in Great Britain, but on the Continent. In the two weeks of almost uninterrupted travel by rail, we met with nothing but politeness and kind treatment from the red-capped Government officials in charge of the stations in Germany, to the guard who politely opens the door and calls out the name of the stations. In this respect "Free America" has much to learn."

But something came over the spirit of his dream, and he takes the praise back thus:

> "Returning to England, determined to get an experience of the different styles of railroad travel, we first traveled first-class on the Northwestern Railway, and found that one shilling would insure the utmost courtesy from the employees of the road, while when that could not be obtained they were as discourteous as possible, and I can say that for fair and square and courteous dealing by railroad employees, the train men in the United States are unsurpassed."

You get as much "politeness" for twenty-five cents in this country as anywhere else.

IT has long been known to every sea going engineer who understands his business, that the most economical vacuum is not measured by the greatest number of inches of mercury. A high vacuum means cold feed-water, and a rise of a few degrees in the temperature will often much more than compensate for the power assumed to be lost. Thus, for instance, a condenser temperature of 100 deg. corresponds to a pressure of less than one pound per square inch. A rise of 15 deg. corresponds to an increase of only half a pound. If it could be shown that the back pressure in the cylinder rose and fell exactly as the temperature rises and falls in the condenser, this half pound might be a consideration. But nothing of the kind occurs. The back pressure is usually about 3 lbs. or a little more, and it is very little affected by a rise or fall of a pound in the condenser; while a rise of 15 deg. or 20 deg. in the feed-water temperature represents a substantial gain.—*London Engineer*.

[Just so, and the need for re-heating feed-water is apparent, if we want the full value of the condenser.—EDS.]

THE recent breakdown of one set of the engines of the '*City of New York*' affords a startling illustration of the enormous cost at which the fast records of ocean racers are obtained. During this vessel's last trip eastward, one of the crank-pins of the port engines was broken, and the trip was finished with the starboard engines alone. Comparing the three days' run with the single set of engines to a corresponding period on the previous voyage with both engines, we find the average ratio of the speeds in the two cases was 0.820 to 1. When they consider that the loss of one-half the propelling power had the effect of reducing the speed by *only* 18 *per cent.*, the promoters of the line of 28-knot steamships will have some idea of the cost of their projected scheme.—*Mechanical World*.

THE commonest adulterant of lard oil is cotton seed oil, and as the latter is half the price of lard oil the temptation to use it is very great. Have your lard oil tested and you may get a surprise. Cotton seed oil is worthless for lubricating.

PROF. CHARLES E. MUNROE, of the United States Naval Institute at Newport, R. I., has discovered a new explosive which is said to possess most wonderful properties. It has greater power than any explosive now in use, while it possesses great chemical stability. Prof. Munroe has tested its safety vigorously. He found that it could not be exploded by a blow with a steam hammer or by glancing or direct blows from a heavy sledge hammer. It is a true chemical compound somewhat resembling the diazo compounds discovered by Greiss. It is smokeless and as nearly noiseless as an explosive can be, yet the claim is made that a single shell charged with it would sink the heaviest ironclad afloat. Its manufacture is said to be safe and easy. The high reputation of Prof. Munroe gives great weight to any claims which he advances, and it is to be hoped that further particulars will soon be obtainable. The composition of his explosive is as yet a secret.

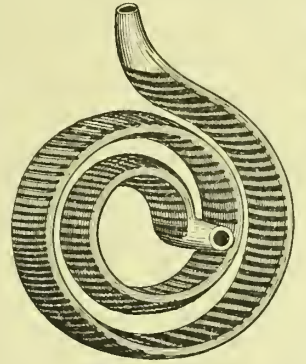
◆

A WATCHMAKER says: "You complain, sometimes that your watch gains a minute a month. You are aware that the balance makes five oscillations every second, which is 432,000 a day; so that, exposed to all the vicissitudes which heat and cold occasion, the varying weight of the air, and the shaking to which it is subjected, it has not varied more than a minute in a month, or two seconds a day. It has only acquired with each vibration of the balance, a variation of the 216,000th part of a second. Judge, then, what must be the extreme perfection of the mechanism of a watch."

◆

VERY LIGHT STEAM BOILERS.

THE engraving represents what is perhaps the lightest form of steam generator known. It can scarcely be called a water-tube boiler, for there is no water in it at any time save for the brief moment during which it is injected, when it is immediately flashed into steam. As will be seen, this belongs to the type of forced circulation boiler, the water being forced in at one end and issuing as steam at the other. This particular tube is very small in area of water passage, so that it is called a capillary tube (from "*capillus*," a hair), but why it is so made we are not told. These boilers rapidly deteriorate from the very nature of their operation. If there is anything that red hot iron loves it is oxygen, and these tubes being more or less in that condition, absorb all the oxygen there is in the water, with the result that they form oxide of iron, rust in plain English, so that the tubes rapidly rust away to destruction. It is simply a question of time, and not a very long time either, when the whole tube will be converted into iron rust. They are therefore not so desirable as some other kinds of boiler.



◆

To prevent the access of air to the cylinder while the vacuum existed under the piston, Newcomen maintained a layer of water on the top of the piston, but, one day, while watching one of his engines at work, he was surprised to see it animated with unwonted vigor, and, searching for the cause, found a hole in the piston which allowed the water to leak into the cylinder, accelerating the condensatoin and producing a much better vacuum than he had previously attained. This suggested to Newcomen the expedient of injecting condensing water into the cylinder, instead of applying it to the outside.

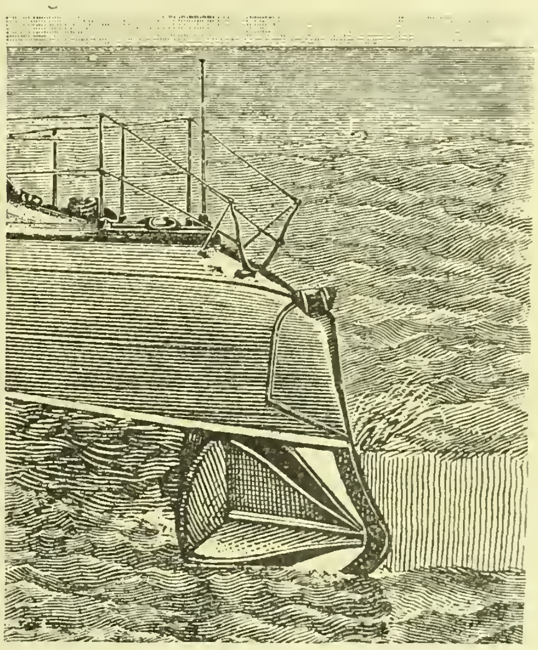
◆

WILLIAM BAXTER, of Newark, N. J., invented and built a compound locomotive which was in practical use as long ago as 1870.

THE LATEST MARINE FALLACY.

OUR readers will pardon us, no doubt, for inserting a cut of the latest marine fallacy, which is said to be the invention of a pupil of Rankine. We find it in the *Mining and Scientific Press*, of San Francisco. It says:

"This patented auxiliary propeller has been invented by an English engineer resident on this coast. Its shape and construction is similar to that of a long-pointed fan, as shown in the engraving, with radial blades tapering to a point in front and increasing in diameter as it approaches the hull of the vessel to which it is attached. The cut shows the application of Stevenson's centrifugal auxiliary propeller to a torpedo boat, from which 50 knots per hour on an even keel is expected. It can be applied to existing ships by cutting away a portion of the stem of the vessel from the water line down and backward as far as is necessary, according to the diameter of fan required; [For 5 feet back from the bow the midship section of a torpedo boat is about 3′ on the water line.—EDS. ENGINEER.] but in constructing vessels to use this apparatus, it would not be necessary to construct a fixed stem, as the fan would take the place of the stem as a rotary snow-plow takes the place of the old fashioned one. This movable stem or auxiliary propeller is not a screw, but simply a fan to clear away the water and the resistance it causes ahead of the hull of a ship moving at a high speed. It is only on high-speed vessels that it can be used to advantage (where the speed is over 15 knots per hour), such as torpedoes, torpedo boats, yachts and steamboats. In speeds above 18 knots per hour the inventor is confident that this auxiliary fan will give more efficiency than can be accomplished by increasing the size and horse-power of engines and screw-propellers.



Here the inventor treats us to a new gospel of the wave line theory. To wit:

"In the case of head pressure or impact, a certain mass of water at rest has to be displaced so quickly that it has not time to form a regular wave, and at very high velocities the water ahead of the ship has to be displaced bodily, as if it was a solid instead of a liquid mass. * * * Mr. Robert Stevenson, the inventor, is an engineer of 20 years' standing, having been educated at Glasgow University under the late Prof. Rankine. He has secured patents for Great Britain and this country, and hopes by the application of the auxiliary centrifugal propeller, to be able to give steamships and torpedoes a speed of 50 knots per hour, and also hopes to see the time when six days will complete the voyage from San Francisco to New Zealand. Mr. Stevenson's idea of the action of the centrifugal propeller is that it makes a partial vacuum in front of the hull of the ship and keeps the water back like solid walls until the hull has entered, and so takes away the head resistance due to the inertia of the water, and causes the ship to be pushed from behind by the water which rushes in to fill up the partial vacuum so formed in front, so that back resistance is also done away with, and by that means the speed of the screw-propellers behind may be increased without the additional loss due to slip, as the screw-propellers will be moving more or less in a mill-race.

If the inventor will take a barrel and make it fast endwise to the bow of a torpedo boat he will get as much value out of it as out of this contrivance, for the resistance of the barrel would be no more than that of the "centrifugal propeller" he has invented.

◆

AN open meeting of *Ocean Marine Engineers' Association* No. 69, hall 189 Bowery, N. Y., will be held Wednesday, February 19. You are respectfully invited to attend and hear the eminent speakers.

RECENTLY an interesting experiment in jumping a torpedo boat over a boom was carried out in Porchester, England. The boom, which was twenty feet in length, differed from the usual spars which are used for the defense of harbors against torpedo attacts, in that it was six feet broad and surmounted by a number of spikes, which it was supposed would receive the boat and hold it a prisoner. No. 49 first class torpedo boat, which had been strengthened for the purpose, was selected to attack the boom. Having made a few preliminary runs in the harbor to enable her engines to obtain full speed, she made a dash at the boom at a rate of about twenty knots. At this speed her stem was lifted out of the water almost as high as the boom itself, which sunk on impact, and before it could rise to the surface the momentum of the craft had carried her over. She was subsequently berthed, and it was found that neither her cutwater nor propeller had suffered, nor had a single plate been bulged or started. The result of the experiment goes far to show that either the booms must be duplicated, or that they must be supplemented with nets, with the object of entangling the screws of the attacking boats.—*Engineering.*

◆

IN spite of the low wages paid to skilled mechanics in Glasgow, the cost of building a locomotive there is considerably higher than it is in the United States. A British locomotive building company, noted for the line equipment of tools used and the advanced system of production followed, built 200 locomotives last year, employing on an average 2,500 workmen. A well-known American firm in the same time built 300 locomotives employing 1,400 workmen. Allowing 300 days for a year's work, the American firm puts the labor of one man for 1,400 days on each engine finished. At the same rate the British builder puts the labor of one man for 3,750 days on each locomotive sent out. The weight and power of the American locomotives greatly exceeded those built in the British shop. This is no hearsay matter. It was a comparison made by the chief executive officers of the two works referred to. The British firm follows largely the American practice of production by piece work, and the process of manufacture appeared to be very systematically carried on.—*Nat. Car Builder.*

◆

A SINGULAR accident happened lately in San Francisco. While expanding the propeller of the '*State of California*' by heat, to remove it, the water which had collected in the hollow of the hub of the propeller was heated, and the steam generated having no means of escape, exploded with a heavy report, blowing the propeller off the shaft, causing it to fall into the bottom of the coffer dam placed on the stern of the ship, and driving the broken shaft back into the ship more than six feet. Fortunately, no one was injured. This cored space in propellers has also caused them to burst by freezing. Every screw should have an inch hole in the hub, through to the chamber.

◆

THE President of the Berlin Physical Society recently exhibited the air-pump constructed by Otto Von Guericke in 1675, which had recently been acquired by the Physical Society. This pump is still in a thoroughly workable condition, with the exception of the glass vessel, which has been renewed. The pressure in this receiver could be reduced to 20 mm. of mercury, by means of the pump. The celebrated Magdeburg Hemispheres, perfect except for the leather packings, were also exhibited.

◆

THE British ironclad '*Vulcan*', which is being built abroad, is having a new rudder weighing twenty two tons, the largest ever put on a British vessel.

◆

WE distrust very much reports of new submarine vessels which are "a complete success" from the start.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

A QUESTION OFTEN ASKED.

Editors ENGINEER:

I am one of your subscribers, and I wish to ask you to accommodate me by answering the following through your paper.

I am a young man of nineteen years, in the employ of a Safe Company of this city, as mechanical draughtsman and designer, but as my work is not of the kind that can cultivate and train my ideas in such a way as to enable me by perseverence and industry to elevate myself to a higher station in life, I have concluded to seek employment where my time may be spent with some chance of gaining a more practical and thorough knowledge of my trade.

I can make mechanical drawings, so far as appearance and clearness goes; so far as their value is concerned I never as yet made a miss. I have a good practical and theoretical knowledge and insight of designing and inventing, and have several articles under way now by which I will soon be able to demonstrate it. I thought that by writing to you, as you are acquainted with new affairs and companies, that you might possibly give me an idea as to where I could try and obtain such a situation in engine, presses and general machine work. Hoping I may profit by your advise and answer. I remain,

J. C. A.

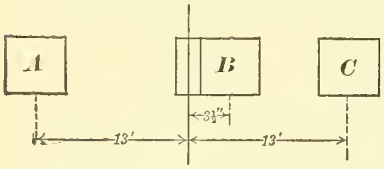
[We should be glad to tell our correspondent where he can find what he is looking for, but situations are not so plenty that we can do so. Young men are wanted all over, but places do not come to them, they have to be hunted for, and he is fortunate who can find them. It comes to this—that all men, young or old are seeking to better themselves in life, and the result depends wholly upon their individual push and energy. No one can do so much in this direction as the applicant himself.—EDS.]

◆

A COAL BUNKER PROBLEM.

Editors ENGINEER:

An argument has arisen between myself and the second engineer on the following question, and we appeal to you for an answer: A ship has three coal bunkers thwart ship, one on each side, and one built out from the keelson of the ship, the intermediate bunker having 88,000 pounds of coal, and it is required to put 80 tons (or 160,000 pounds) into both the other bunkers. How much shall be put into each that the ship shall be balanced—or lie on an even keel? The distance of the centers of the bunkers is given in the annexed cut.



E L. BENSON.

Portland, Me., Jan. 26, 1890.

The easiest way to determine the respective amounts will be to first find how much coal in bunker A will balance the 88,000 pounds in B. This amount will be

$$A\times13=88{,}000\times3\tfrac{1}{2},$$

$$\text{or, pounds in } A=\frac{88{,}000\times3\frac{1}{2}}{13}=23{,}693$$

When this amount has been put in A, it will balance the coal in B, and after that equal weights in A and C will balance each other. Subtracting 23,693 from 160,000 leaves 136,307 pounds to be divided equally. Dividing by 2 gives 68,153½ pounds to be put in C, and the amount in A will be

$$68{,}153\tfrac{1}{2}+23{,}693=91{,}846\tfrac{1}{2}\text{ pounds.}$$

EDS.

◆

TO MEASURE QUANTITY OF AIR PASSING THROUGH A FURNACE.

Editors ENGINEER:

How do you ascertain the volume of air supplied under the grate bars with natural draught?

What is the theoretical evaporation due to the combustion of one pound of petroleum?

GEO. BLAKE.

Owosso, Mich.

To measure the quantity of air passing through the furnace, throw a shovelful of green coal (bituminous) on a red fire. Time the moment it strikes the bed and the moment black smoke issues (as it will) from the top of the stack. This will be some part of a minute. Then take the area of the stack and multiply it by its height. This gives so many cubic feet, or inches, of air passing through in a given time. This is a crude way of arriving at the end desired, and is only approximately correct, for the air does not rush into the furnace at the same speed that the products of combustion go through the stack. A better way is to use a machine called an anemometer—wind gauge—in front of the ash pit This will determine the velocity of a volume of air of a given cross section passing under the grate bars per minute.

Total units of heat in one pound of petroleum, 20,360; evaporation equals 21 pounds of water from and at 212.

FROM MARINE ENGINEERS' BENEFICIAL ASSOCIATION, NO. 2, CLEVELAND, OHIO.

Editors ENGINEER:

Agreeable to a resolution passed by Marine Engineers' Beneficial Association, No. 2, I enclose herewith an invitation and complimentary ticket to our Annual Ball, on February 10, and if you will favor us with your presence we promise you a good time.

However, I do not suppose you will be able to attend, but I beg leave to say to you that we do not send this merely as an act of formality, but rather as an expression of our appreciation of a tried and true engineer, and one who has always been a faithful friend to our fraternity.

F. B. SMITH,
Cor. Sec.

[The Brothers of No. 2 have our thanks for their courtesy. Their good will is beyond a cold "thank you," and is prized far more than we can express.]

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N. A. S. E. NO 1, CHICAGO.

Editors ENGINEER:

The following members were elected to office for the ensuing year. President, William Ponsonby; Vice President, F. Gager; Treasurer, Geo. Mansfield; Financial Secretary, John O'Connor; Recording Secretary, L. Tanner; Conductor, Jas. Rennie; Corresponding Secretary, D. B. Ramsay; Doorkeeper, David Ponsonby; Trustees, John Miles, M. L. Tierney; Chas. Paul.

* * * *

Chicago, Ill.

◆

FEW appreciate the great loss of heat from uncovered or imperfectly covered pipes. Many have an indistinct impression that there may possibly be some slight loss, but there is in many cases an absence of knowledge upon this subject where it should be complete. The most correct data available shows that the radiation from uncovered two-inch steam pipe, with 60 pounds steam pressure, is 391.83 kilo. centigrade heat units 1 foot 1 hour, or 21,739.78 kilos. of coal for 100 feet per year of 300 days of 10 hours each; 1 kilo equals 2,205 pounds. Properly combining these figures we see that there are 23.97 tons of coal lost by radiation from that uncovered pipe. If the coal costs $4.00 per ton, the radiation from this 100 feet of pipe will amount to $95.87. From the same pipe covered with Berkefield's fossil meal composition .92 inch thick, the most powerful in organic non-heat conductor used as a covering at the time these investigations were made, there was radiated 24,109 kilo. cent. heat units one foot 1 hour, or 1,337.63 kilos. of coal for the year. This would be 1.0474 tons of coal at $4.00 per ton; amounts to $5.89. Then $95.87 less $5.89 equals $89.98, the saving effected by covering this pipe with fossil meal composition .92106 of an inch thick. Or in other words, the saving effected was over 93 per cent. of the total possible radiation; using a thickness of one inch this loss would be reduced to $5.50. —*Childs.*

◆

HOW many ever heard of how Edison made an electric bug? Edison proposed that the wires be put in the gas pipes; but how were the pipes to be "threaded" with the wires? After studying the matter one night, Edison said to a fellow-electrician, "I'll make a bug that will drag a wire through every foot of pipe in New York, if necessary." "Make a bug! what in the world do you mean?" "Well, I'll make a bug," said Edison, "that will go where I send him, and drag a wire, too." A few days afterwards he laid a curious thing on the table in the office; it was his gas-pipe bug, constructed thus: a minute electro-magnet, carrying behind it a fine insulated wire pawl. Every time the circuit was closed the pawl clutched the sides of a gas pipe, and the magnet behind was drawn toward the armature about the sixteenth of an inch; when the circuit was opened the armature reached forward ready to take a second step. Thus, at every closing of the circuit the bug advanced one step, dragging the wire behind.

◆

ABOUT the best way to meet the race issue is for every idler to go to work in some respectable calling. This would at once stop it and make people happy.—*Palatka* (*Fla.*) *Herald.*

◆

TAXPAYERS are beginning to kick against manual training schools in some places. The cost of the tools is not a small item.

IT PAYS TO ADVERTISE.

OUR readers will admit that we do not trouble them much with sermons on the great value of advertising in this paper; indeed some accuse us of too great indifference on this score, but we beg leave to publish one reference to the value of THE ENGINEER in this respect. and promise not to offend again. It was sent us by a zealous friend in Kansas, who takes a personal interest in THE ENGINEER, although we have never met.

"In one of your back numbers there was a description of Blank & Co.'s lathes and workmanship. On the strength of that article I sold a lathe for them. The parties that are getting this tool are Brown, Jones & Robinson, neither of whom know anything about a lathe, but they left the matter to me. After looking over a dozen different makers' tools, I concluded that this was the best for the money. Perhaps this does not interest you, but I think it does. THE ENGINEER had a great deal to do in making that sale. That means that your description of their work, together with the knowledge I have as machinist, sold the lathe. I expect to see the work on that tool, just as you said—first-class workmanship. So much for THE ENGINEER; but where, oh where, is their ad. gone to?"

The ad. has gone out; it lasted just six months, and died for want of breath. This testimony is of interest in this light: That it is always a good investment to advertise in papers of acknowledged status and legitimate, paid-in-advance circulation, whether heard from at once or not. THE ENGINEER is such a paper. The advertisement cost the advertiser $20.00, and they got in one order $270.00 to our knowledge. How much more we don't know.

◆

CONCERNING FOREIGN RAILWAYS.

J. A. COLEMAN says: "Arriving on the other side, one of the things which first struck me and which I will always remember, is the excellence of the roadbeds and the avoidance of curves, but the first time I ever experienced anything like real comfort and luxury in foreign travel was in 1874 between Vienna and St. Petersburg on a trip from Egypt to Russia. However, they have nothing in Europe to match the comfort of railroad travel in this country. I lived in France some seven years and found them very slow in introducing even such accommodations as sleeping cars, and I have paid seven dollars for a berth for an eighteen hours' ride from Paris to Marseilles. My idea of real suffering is to travel night and day in a first class car in France. In Germany the first-class cars are luxurious and the second-class are equal to the English first-class. The seats of our cars are not as comfortable as many of those on the European railways.

"I think the difference between our American system and the European is that over there everything is done for the roadbed, but the running gear of the cars does not receive the same attention, and they are so constructed that they must have a straight road or they would not run. Take one of their trains and put it on our roads and you could not go at anything like reasonable speed and keep the train on the track."

◆

THE official lists all credit war ships with much greater engine power than they really possess. A horse can exert a pull of over 600 lbs. for a brief interval, but no one in his senses would therefore assume that he could always get work represented by that pull out of a horse. But because a ship has for a few hours exerted 11,000 or 12,000 i.h.p. with forced draught, she is credited with possessing engines of that power, when, in all probability, her real staying power, as we may call it, is 8,000 or 9,000 horses. If the truth in this respect once came to be understood, mistakes would be avoided, and much trouble saved, not only to captains but to engineers.—*London Engineer.*

◆

THERE are no hod carriers in Japan. A man makes balls of mortar, and pitches them up to a man on a ladder, who in turn pitches them to another man on the roof. Piece work, so to speak.

NATURAL FORCES.

THE force of gravitation is the force which keeps the earth and planets in their orbits, the invisible but potent cord which binds together the members of our system. We have heard the fact stated so often that it is an old story, and accept it without further thought. But consider for a moment how great this force must be! A bar of steel one quarter of an inch square can sustain a weight of about 7,500 pounds, or the weight of fifty full-grown men. Now, simply to hold the moon in its orbit, we should have to have a colossal bar of steel, stretching from the earth to the moon, whose section would be 87,500 square miles! As large as the whole State of New York, with 536 miles over for good measure. Or if, instead of one single hugh bar, we should stretch a forest of steel bars, each bar one-quarter of an inch square, from the earth to the moon, we would have to cover the entire surface of the earth on the side toward the moon with such bars at intervals of only six inches. Think of it! A forest of steel whose stems would be so close together that a cat could scarcely squeeze through. This is what the "force of gravitation" means. Take another illustration of the mighty forces amidst which we live so securely and so unconsciously. The mean rainfall on the earth may be taken at, say, five feet; the mean height of fall at about 900 feet. We have, then, the average power of the rainfall per square mile, about 445 h.p. The work performed, then, by the sun's rays in simply raising our yearly rain supply, without which all life would perish utterly, is 87,630,000 h.p. In comparison with this the puny 20,000,000 steam power of man sinks into utter insignificance. This steam power is, however, only the utilization by man of the merest trifle of the sun's heat, stored away in past ages and bottled up for future use, in the shape of coal and wood. Such are some of the giant forces in the midst of which we live. Forces so delicately balanced, so nicely adjusted, that such estimates strike one as incredible. And all these mighty forces to-day are going to waste on every hand! The direct rays of the sun, the rise and fall of the tides, electricity, magnetism, gravitation; these and many others—all strong servants—stand willing and waiting for the master who shall bend their vast energies to the service of humanity. Shall they always stand and idly wait? Is it too much to expect that the same persistent study of nature which has in the past achieved such wonders, and which has already subjugated one of nature's great forces, and in doing so ushered in the civilization of to-day, will yet conquer the others also, and thus achieve results compared to which all that has yet been done will seem insignificant? The great and beneficent forces of nature are but just beginning to be utilized and brought under control and direction. One only of these forces we have but very imperfectly captured. Heat alone has become our servant, but the giant wears his chains lightly, and sometimes breaks them in derision. Our foot is not yet upon his neck, and he works for us with but a single finger. It remains to secure the entire and hearty service of all his mighty strength, and to enlist with him his now idle yet equally powerful comrades in united efforts for the advancement and prosperity of mankind.—*Prof. A. J. Dubois.*

◆

THE latest unique invention is a machine for buttering bread. It is used in connection with a patent bread cutter, and is intended for use in prisons and other institutions. There is a cylindrical brush which is fed with butter, and lays a thin layer on the bread as it comes from the cutter. The machine can be worked by hand, steam, or electricity, and has a capacity of cutting and buttering 750 loaves of bread an hour. The saving of butter and of bread and the decrease in the quantity of crumbs is said to be very large.—*Mechanical World.*

WILSON'S VALVE GEAR.

WE illustrate below a three-cylinder engine fitted with a valve gear devised by Mr. Matthew Wilson, Glasgow. This gear avoids the use of eccentrics and economizes the space they occupy on the shaft. It may be explained in a few words. Designating the cylinders 1, 2, 3, and numbering the corresponding cranks, which are supposed to be 120 deg. apart, in like manner, No. 1 valve is driven off No. 2 main crank; No. 2 valve off No. 3 crank, and No. 3 valve off No. 1 crank. This arrangement is possible because the eccentric, if there were one, for driving No. 1 valve would be set at about 120 deg. in advance of No. 1 crank, that is, it would correspond in position to No. 2 crank, and may be replaced by that crank if care is taken in fixing the lap and lead so that the angle of advance required is exactly 120 deg. This is what Mr. Wilson does; he designs his valve so that the angle of advance of the eccentric shall be 120 deg., and then he makes the crank of the adjoining cylinder replace the eccentric.

In practice it is more convenient to work off the crosshead than the crank. In a non-reversing engine two levers connected together by a sleeve are employed; one lever is coupled by a link to the crosshead of an engine, and the other to the valve of the next engine, and the stroke is adjusted by the proportions of the lengths of the two levers. Calling the right hand engine in Fig. 1 No. 1, it will be seen that its valve is driven off the crosshead of No. 2 engine by two levers cast on one sleeve, which is loose on the shaft. No. 2 valve is similarly driven. No. 3 valve is driven from No. 1 engine, the motion being conveyed through the shaft on which the sleeves are threaded. In a reversing engine, such as a triple-expansion marine engine, the same arrangement is followed, except that the valves are worked off the air-pump levers, and that the relation of the cranks and cylinders is changed when the engine is reversed. Thus, in going ahead No. 1 valve is worked by No. 2 crank, and in going astern it is worked by No. 3 crank, and so on. The air-pump shaft is extended in the case of No. 1 and No. 3 engines, and the two loose sleeves moving on the air-pump shaft of No. 1 engine drive No. 1 ahead and No. 2 astern. The movement taken from the levers is conveyed to the link for reversing in the usual manner.

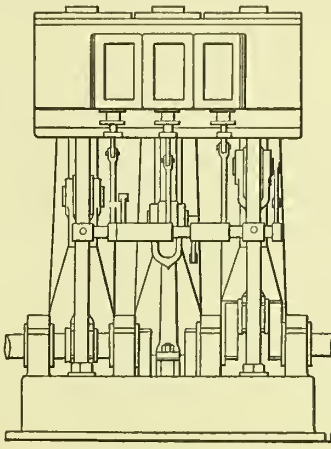
Fig. 1.

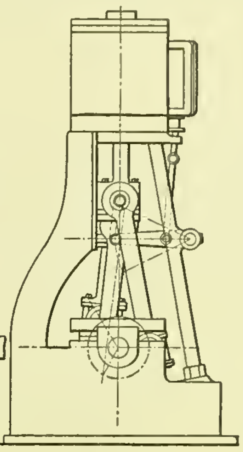
Fig. 2.

It will be seen that the gear is exceedingly simple, and that it offers very little chance of breakdown, while it enables the valves to be placed at the side of the cylinders, thus economizing space.—*Engineering.*

◆

THE brothers of M. E. B. A., Cleveland, O., have our thanks for complimentary to their ninth annual ball, which occurred on the 10th inst. and was a most enjoyable event.

◆

D. B. COBB, of South Brooklyn, the well-known proprietor of the Cobb Surface Condenser Works, died of pneumonia on the 31st ult., aged sixty-eight years.

◆

THE employment of direct condensation was a discovery—not an invention.

BELT POWER.

WHILE it is an easy matter to ascertain the speed of a belt, it is not so easy a matter to determine exactly the amount of tension that it is submitted to. A six-inch belt, for instance, may run 2,000 feet per minute and at a tension of 100 pounds to the inch in width, will transmit 40 per cent. of that tension, which is equal to a frictional power of 240 pounds. If this be multiplied by the speed and divided by 33,000 the quotient will equal the power, thus 6×40=240×2,000=480,000, the number of foot pounds given out per minute; then 480,000+33,000=14.54 horse-power. All this may be simple and very easy, but suppose the same belt is taken up so that its tension is increased to 200 pounds to the inch in width, then at the same speed the result would be quite another thing. The whole conditions are changed and the result will be as follows: 200×.40=80×6=480×2,000=960,000 foot pounds per minute, then 960,000÷33,000=29 horse-power. So that if the tenant rented and paid for 14 horse-power based upon a certain tension of the belt, if he is disposed to do so by doubling the tension of his belt, while he is paying for only 14 horse-power will be using 29, and how is the landlord to know just the amount of tension that the driving belt of his tenant is subjected to, especially when it is taken up without his knowledge, as is most frequently the case? Therefore, renting power and estimating the same by the width, tension and speed of the driving belt is a very uncertain and in most cases a very unsatisfactory method of proceeding. By the use of a speed indicator the power consumed in such cases could be determined in a much more satisfactory manner. A tenant who rents power sufficient to operate certain machines should be willing to pay for the same, and is entitled to no more. Therefore, the proper method of determining this fact is to give the driving belt sufficient tension to successfully operate all the machinery at once, each machine working its full speed and capacity, then, after noting the speed of the line shaft, stop all the machines and apply the brake in the manner described, keeping the line shaft at the same speed but not checking it below that point, and then by figuring up the resistance offered by the formula given, if the results are not perfect they will be near enough for all practical purposes. In the majority of cases they will be satisfactory to both parties. Much dissatisfaction and frequently expensive litigation might be avoided by having on hand a cheap and convenient apparatus of this kind. —*C. S. Tompkins, in American Miller.*

◆

A NEW low-pressure vertical engine for small powers, 10 to 12 h.p., has been introduced abroad, which has some novel features. There is a surface condenser in a vertical position, round which a continuous current of water is passed. The water supply is obtained from a tank similar to those used with gas engines, so that the water can be used over again, with occasional replenishments to compensate for the slight loss. After the engine has been working for a short time the water becomes 100° to 150° Fahr., and a considerable mineral deposition takes place where salts exist in the water. The water of condensation is pumped back into the boiler, and it is found possible to maintain an unvarying water line. The same water is used repeatedly, and if it were not for the slight loss resulting from escapes through the stuffing boxes, etc., there would practically be no fresh water needed. It has been established that about two quarts of water per h.p. per day will supply all loss in the engine or boiler. This quantity is obtained from the condenser by means of a slight drop-feed, the rate of the dropping being regulated by a valve. In this way the feed-water is kept pure and incrustation of the tubes prevented. The small consumption of water is remarkable, but is verified by a large number of users in various parts of the world.

THE ENGINEER.

FORTNIGHTLY. . . . $2.00 PER ANNUM.

Foreign Subscriptions, - . . . . . 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, FEB. 15, 1890. No. 4.

ADVERTISING.

Next to reading matter, per inch, each insertion	$2.40
Second, third and fourth pages, per inch, each insertion	1.80

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HIGH EXPANSION STATIONARY ENGINES.

A SUBSCRIBER asks: "If high expansion engines are so economical in marine practice why are they not used more in stationary practice?" They should be, and in a few isolated instances they are. Compound engines are common enough, but they are not high expansion engines. Triple and quadruple expansion engines in use on land can be counted on the fingers of both hands. There are some reasons for this which are comprehensible enough from a certain standpoint, but not from an engineer's. In the first place, the Corliss type of engine is universal, and the patterns for it are in almost every city or town of prominence in the country. These could be used for high expansion engines, and well enough on all three cylinders, even with 160 pounds in the high-pressure cylinder, for, although the Corliss valve is stubborn to move under very high pressures, the great back pressure on the h.p. side would doubtless render it tractable enough. The fact remains, however, that stationary engine builders have had little or no experience in making high expansion engines, and, naturally enough, do not care to make experiments, or put themselves to unnecessary trouble and expense, unless customers will not take any other kind of engine. The buyer makes the market, and unless there is a call for high expansion engines they cannot be sold. Moreover, the first cost of high expansion engines is very much greater than a single or a compound engine, and this is a fatal objection in the buyer's eyes. The most engine for the least money is their motto, and they do not look into future savings at all. The figures on the immediate check are much more potent in arriving at a decision than a promise of 15 per cent. on fuel in the future. Another objection to high expansion engines—in the buyer's eyes—is that they require very high pressures to develop their efficiency, and this means a more expensive boiler, so that, taken altogether, the system does not recommend itself to persons who do not know, and do not care to know, anything about it. The average automatic engine, single cylinder, in average hands, will use four pounds of coal per horse-power per hour. Plenty of them are running for much less, but we speak of engines all over the country. A compound engine will use $2\frac{1}{2}$ to 3 pounds of coal per horse-power per hour, while a quadruple cylinder engine should develop a horse power for $1\frac{1}{2}$ pounds of coal in the same time. In a word, as the expansions increase in number in multi cylinder engines, the coal consumed decreases, whether on sea or on land. This is the testimony of all who read and follow current practice, and in reviewing it all it still seems incomprehensible to engineers that manufacturers should be so blind to their own interests. One of these days, when some large concern declares a big dividend, to which they were helped by an economical high expansion engine, the eyes of directors and managers will be opened. Then there will be a craze, so to speak, for high expansion engines. Every new system has had to go through the same routine. The old two ball governor throttling engine held its own for a long time. Where is it now? Ask the automatic engine. The old-fashioned slide valve is gone but not forgotten, by any means. In time we shall have high expansion engines as common in factories as they now are on board ship.

◆

BEFORE straining oneself to make a compound locomotive, it might be as well to find out beyond peradventure that they are really necessary. The advocates of them claim only 15 per cent. over an ordinary engine, as regards economy of fuel. As regards economy of repair and lubrication, it is easy to spend this 15 per cent. and more.

◆

ENGINEERS all over the globe will regret to hear of the death of M. A. Hirn, the famous Alsacian engineer, which took place in Colmar in January.

SHORT-SIGHTED INVENTORS.

A FEW months ago an inventor of certain apparatus of a very simple character, which could have been readily duplicated in many different forms, was offered $6,000 for the right to a certain inland town. He was a poor man and needed the money badly. The reader supposes, of course, that the inventor jumped at the chance and pocketed the money on the spot. Not he; he told the buyer that the patent was worth $100,000, and he was not going to sell one town in New York State for $6,000. The same inventor was offered a similar sum for another large town in the State, or $10,000 for only two cities in the country, but he refused to take it. We have these facts from the inventor himself and they are correct. Before it was too late to negotiate, we berated the man soundly for his folly but he was deaf to all argument. The sequel was that the inventor never sold a single right and has his patent to this day.

The fatuity of inventors on this one point, the value of their patents, is wholly incomprehensible from a business point of view. If a farmer were offered $10,000 for ten bushels of potatoes and refused it upon the ground that the bushels would produce tons of potatoes he would be no more inconsistent than the inventor who refuses a good round sum of money for an unmarketed invention. Yet this is what they do every day in the year. There are men walking the streets in poverty who have devices of more or less value, which, in the hands of business men, would have commercial value, that they refuse to part with because they are not paid highly enough in their own estimation.

Let inventors remember—for their own good—that an undeveloped, unmarketed invention is of no more value than the paper the patent is written on. It has possibilities, no doubt, but these last are intangible, and before they can be converted into dollars and cents another head must be called in, and, as his risks are greater than the inventor's, he must have an adequate reward. Every patent of any prospective value even, has to be litigated sooner or later, and this costs money; its value is not established until the absolute priority of the patent is settled. If inventors would only bear these facts in mind and sell their inventions as soon as possible, there would be fewer disappointed patentees.

ANOTHER "TRACTION INCREASER."

SOME years ago a peculiarly foolish device for "increasing the traction" of a locomotive was put in practice down East. This device was to destroy the continuous adhesion of the tire by cutting a number of flat places in it, the proposition being that these flat places "held on," or created more traction by increasing the surfaces in contact, whereby the friction, or, in other words, the adhesion of wheel to rail, was increased. This device actually found persons to encourage it, and it is to-day upon a locomotive. This locomotive has been run upon several roads in the country. So far from being any advantage it is a detriment. Increasing the surfaces in contact does not increase the friction, unless the load is increased. The frictional contact of a wheel with a rail is the same under all circumstances with a given load, and no sort of device can increase or decrease it, so long as the wheel is a true circle. This device actually decreases it, as anyone can see by rolling a hexagonal nut on a plane surface. The action of the angle formed by the alleged flat surfaces is to lift the wheel-face off of the track, which action is repeated as many times as there are angles in the face. It is a preposterous suggestion to even consider, let alone try.

◆

WE hoped to be able to present an engraving of the U. S. torpedo boat '*Cushing*' in this issue, but a letter to the Herreshoff Company requesting a photograph was not even answered.

INDIVIDUAL MERIT.

THE world is full of young men who are anxious to place themselves comfortably and to attain positions of responsibility and trust before they are fitted for them. They mean to reap before they have sowed, and if obstacles supervene they become discouraged, and fall back. Some rely upon the good offices of friends to give them advancement, and some seek the friendship of public men for the same purpose, but all these mediums fail utterly unless the young man himself is worthy and capable. If he possesses these latter qualities he need not seek the favors of anyone to put him in a place; he can put himself where no sort of adventitious aid will avail. Say what we may, the only success which succeeds is individual merit. A young man who strives earnestly to get ahead, and fits himself for a high position cannot be kept out of it; he floats on top of the common herd as a cork floats on water, and he cannot be kept down. But he must be in dead earnest, and love his work, for neither hunger for fame or a desire for notoriety will avail him any in the struggle. If he is not in earnest others are, and in the whole race of life it is only the solid man who wins. The fool saith in his heart: "there is no use trying," and he falls by the wayside before the struggle has really begun. One of the foremost engineers in this or any other country said to us lately: "I learned the calculus after I was forty-three years of age," and this is a whole sermon in itself. He did not study the higher mathematics as an accomplishment, but because he felt that it would open to him avenues for information which were previously unknown to him. A thorough practical education and knowledge of any business is better than money in a bank, for it never fails to pay interest, and the capital is constantly increasing. Now is the time, young man, to make the first deposit.

◆

BEST RATIOS OF EXPANSION FOR MULTI-CYLINDER ENGINES.

AT the close of an article on multi-cylinder engines, by Prof. R. H. Thurston, he says: "It will, however, for the best effect on the whole, be probably advisable that the work, the effective initial pressures, and the several differences of temperature, shall be as nearly equal in all cylinders as possible. To meet the first condition we must have such a ratio in each cylinder as shall make the work in each equal to the total net power of the engine divided by the number of cylinders in series. To meet the second condition we must make the initial pressure in each such that the total range of pressure may be equal to a common range in each multiplied by the number of cylinders; while to make the range of temperature equal throughout the series, we must have varying differences of pressure, the high-pressure cylinder having the maximum range, and the low-pressure cylinder the minimum range of pressure. The differences in this latter respect are, in engines using very high steam pressure, quite considerable. Where the steam is dry, the speed of engine high, and the jacketing effective, this is a matter of less consequence than approximately uniform division of work and stresses on the crank-pins."

◆

THE height of ocean waves has recently been measured in a very ingenious way by floating a sensitive aneroid barometer, to which a recording apparatus was fitted, on the surface of the water. It has thus been proved that the waves attain a height of 40 feet from trough to crest in a fairly heavy sea, and probably much more in very violent gales.

◆

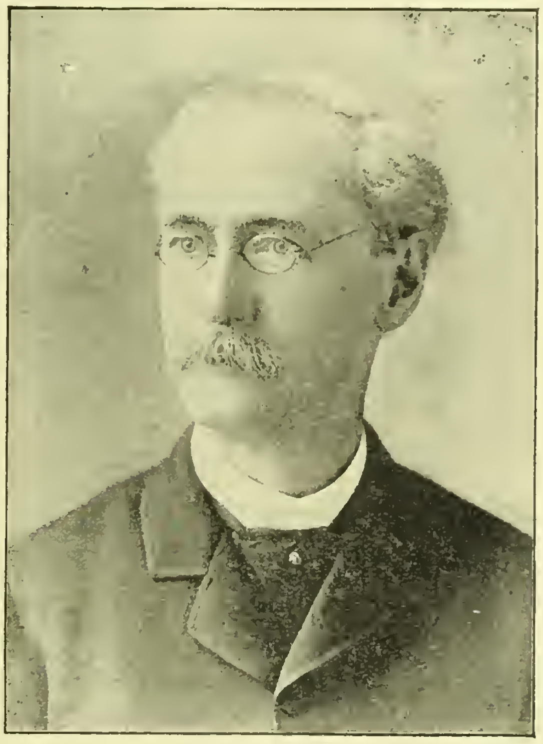
EXPERIMENTS on a French railway with a dynamometer showed the tractive resistance to be 5½ lb. per ton of train-load at a speed of 15¼ miles per hour on the best parts of the line; 7.7 lb. on a curve of 138 ft. radius, and 16.5 lb. on an S curve of 65,6 ft., at a speed of 6.2 miles per hour.

FAMOUS AMERICAN ENGINEERS. NO. 6.

CHARLES B. RICHARDS, PROF. STEAM ENGINEERING, SHEFFIELD SCIENTIFIC SCHOOL, YALE UNIVERSITY.

PROF. CHARLES B. RICHARDS, whose portrait we present herewith, was born in New York in 1833, and is, consequently, fifty-seven years of age. He is a thoroughly practical engineer and machinist, having served an apprenticeship to the trade in the shops of Woodruff and Beach Co., at one time engine and machine builders in Hartfort, Conn. Mr. Richards remained three years with the firm, after finishing his time, and then engaged with the Colt's Patent Fire Arms Company of the same city, as chief draughtsman. In 1859, Mr. Richards came to this city and established himself as consulting engineer; in 1861 he invented the Richards' Steam Engine Indicator, which was first introduced in England and subsequently on the Continent, where it took precedence of all others. It was also used extensively in this country.

On the outbreak of the War of the Rebellion Mr. Richards returned to Colt's Patent Fire Arms Company, where he assumed charge of the manufacture of 100,000 United States rifled muskets, and upon the completion of the contract was appointed superintending engineer to the Company. While holding this position, Mr. Richards also acted as consulting engineer for the construction of the State Capitol building at Hartford, Conn., furnishing the plans for heating and ventilating it, acting also as principal adviser for other public buildings. Professor Richards remained with the Colt's Patent Fire Arms Co. until 1880, when the Southwark Foundry and Machine Company was organized, and Professor Richards was made superintendent of it, where he remained until called to the Professorship of Mechanical Engineering (in 1884) of the Sheffield Scientific School of Yale University, New Haven, Conn., where he now is.



Professor Richards held the appointment of United States Expert Commissioner to the last Paris Exposition for Group VI, which included all machines and appliances of the mechanical industries. Professor Richards was one of the first members of the present American Society of Mechanical Engineers, and is now the vice-president of that body. He was also a member of the American Society of Civil Engineers for eighteen years. In manner and speech Professor Richards is retiring, and it was only upon the representation that our record of American Engineers would be incomplete without his, that he consented to favor us with the photo herewith presented.

ERICSSON'S AMIABILITY.

CAPTAIN JOHN ERICSSON is known to many as a stern, determined man of very little amiability, but the facts are that he was an exceedingly agreeable man to those whose personality was acceptable to him. He was very averse to personal interviews and would, as a matter of choice, have sooner given away $50 than ten minutes, but he yielded sometimes when he thought the occasion warranted it, and he knew the applicant for his favor. He especially detested inventors of this or that, and, as he once told the writer, "if I yielded to their importunities I could spend my life doing nothing else."

A young man, who shall be nameless, thought some fifteen years ago that he had invented a screw propeller which had novel features of value. Knowing Captain Ericsson through some transactions, he naturally wished for his opinion of it. He applied for an interview and was told that Captain Ericsson would see him for ten minutes. Armed with the model boat 4′ long by 8″ beam, he presented his scheme. The Captain came in a great haste, examined the screw without saying anything, and then turned to the visitor and said: "It is not worth one damn."

"It is a true screw, Captain Ericsson."

"Oh! a true screw, is it? Well, sir, what are you trying to do? A true screw the size of that door," pointing out the large doors of the parlor, which were, perhaps, 4′.6×8′, "now drives an ocean steamer twelve and fourteen miles an hour. Do you think you can beat that? No, sir, you cannot beat it. I do not care what shape your blades are, you cannot get more than a true screw will give, and that is all there is about it." Dismissing this part of the subject, Ericsson examined the model with great interest It was a working model carrying two cylindrical copper boilers, 2″ diameter by 12″ long, making steam of 150 or 200 lbs. per square inch, and driving a ¾″×¾″ piston at 1,000 revolutions, more or less, per minute. The wheel was 5″ diam. by 5″ pitch, and the boat made, by actual timing with a watch, at the rate of four miles per hour; allowing 25 per cent. for slip of wheel, this would give about 1,000 revolutions per minute. Captain Ericsson asked how fast the boat had been driven, and was told as above. He shook his visitor heartily by the hand, and said, "You have done a great thing, sir. I could never drive a model more than two miles an hour."

When the Captain chose, no man could be more courteous or considerate than he. Candor compels us to say that he could also present a terrible front to an enemy.

◆

CREDIT WHERE CREDIT IS DUE.

SATIRICAL Thomas Carlyle said once that the population of England was about 30,000,000, "mostly fools." Thomas said this in his wrath; we would like to have heard his opinion of the passengers on steamships who get up testimonials like this:

> *Whereas*, On the present voyage from Liverpool to New York the steamship '*Celtic*' has encountered weather of unprecedented severity; be it
>
> *Resolved*, That we, the undersigned passengers, desire to express to Capt. Henry Parsell, R. N. R., our deep appreciation of the ability with which the ship has been handled and to assure him of the confidence which has been inspired by the masterly manner in which he has foreseen and provided for each emergency, as well as to thank him for the courtesy and attention which all on board have received.

It would not have cost them much to have included the chief engineer and his assistants in their testimonial; they would only be doing justice to men who deserve much. Suppose the engines were not running or kept up to their work in a gale of wind, then what?

◆

A PERMANENT and durable joint can be made between rough cast-iron surfaces by the use of mineral asbestos mixed with sufficient white lead to make a very stiff putty. This will resist any amount of heat, and is unaffected by steam or water.

Foreign and Domestic Trade Literature.

BREAKING THE RECORD.

THE good ship '*Atalanta*' was being driven "all she knew" into a head wind and sea, till her masts fairly shuddered, as wave after wave swept up to her bows, and parted with a thundering roar before her sharp cutwater.

Now with her bows raised high in the air, as she breasts a gigantic sea, now diving down into the trough beyond, trembling from stem to stern, with the "racing" of the engines, as the propeller is lifted nearly out of the water, then all but stopping as she plunges at the next huge wave and buries her nose in it, the engines nearly pulling up dead with the tremendous strain brought on them by the sudden immersion of the screw as her bow is again lifted and the decks swept fore and aft by a heavy sea, she holds on her stormy way.

On deck no one is visible but the officers and men on duty, the passengers being either safe in their berths or lying scattered about the saloon settees in a half-inanimate condition. Down in the engine-room, the two engineers on watch—senior and junior—have their hands full, as, with every roll of the ship, coal, shovels, and rakes go sliding about the stoke hole, and the firemen have hard work to keep their feet as they heave the coal into the insatiable furnaces. The "greaser" crawls cautiously about, never letting go the hand-rail with one hand, while he holds the oil-can in the other, watching every pitch and roll of the ship, and revolution of the engine, to get an opportunity of dropping the oil into the cups without being pitched headforemost into the crank-pits, or knocked senseless by the "cross-heads" or "pump-levers." Night is fast closing in, and the huge engine seems wrapped in a misty twilight, except just where a solitary lamp throws a stream of light on the steam-gauges and clock, which are fixed just in front of the starting-platform. Suddenly, as the electric light is turned on, everything flashes out, bright and distinct, and the "moving-rods and links" flash back rays of light from their polished surfaces. The engineer, standing by the "throttle-valve lever," his whole attention, for the time being, taken up with watching the pitching of the ship, and preventing "racing" of the engines with the throttle—for the "governor" has suddenly refused to act—glances wearily at the clock and wishes for eight bells. The huge ship creaks and groans as she is struck again and again by the seas, and the incandescent glow of the electric light rises and falls, for it is impossible to keep steam steady in weather like this.

Half way up the side of the engine-room, standing on a grating close under the main steam-pipe, are two or three engineers, working as if for dear life to get the obstinate governor into working order; and presently a shout announces to the one below the welcome news that the work is done. As the connecting-bolt is put in place, he lets go the handle of the throttle, which, worked by an air-vessel in the stern, shuts and opens itself with superhuman force, as the propeller is lifted clear of the water, or again plunged deep into the waves.

The "governor" being now in good working order, the engineers not on watch disappear up the ladders, and the second and his junior begin preparing for the welcome relief which comes at 8 P. M., when the fourth takes the watch till midnight.

All coal contains a certain amount of dirt and slag, which soon chokes up the fires, of which a certain number are consequently cleaned at the beginning of every watch. In rough weather this is no easy work; the fire has to be pushed on one side, the clinker pulled out, the embers spread over the bars again, and fresh coal put on. Yet the firemen manage to keep their feet while working the heavy rakes and "slices,"* and avoiding the hot clinkers and ashes as they rake them out of the furnace; their figures now standing out clear and distinct as silhouettes against the glare from the open furnace doors, now half hidden by clouds of steam, as the hose is turned on the hot clinkers. On one side stands the engineer holding open the furnace door with a shovel, and urging on the firemen to hurry up and get the fire in again before the steam drops too low. Just as the last fire is finished, a tremendous pitch and roll sends men, coals, barrows and shovels sliding down the stoke-hole in a confused heap, and for a few seconds the stoke-hole is a very pandemonium of confusion. Then comes a pause as the ship rights and an awful stillness. As the stern of the steamer lifted, the engines, acted on by the governor, slowed down, and now they have failed to go on again, as the stern drops. Something is wrong with the governor.

The engineer rushes into the engine room, the engines are crawling round dead slow, and the junior engineer, with his feet against the bulkhead and his shoulder against the throttle valve lever, is exerting his utmost strength to open the valve which has been jammed shut by the too sudden action of the governor.

"Can you manage it?"

"No, bring a hammer."

A rush into the store—and, as the engineer reappears with a copper hammer in his hand, the rising steam lifts the safety-valves, and a sudden dull roar, as it rushes up the escape-pipes, warns him, and shouting to the firemen to close the dampers, he rushes up the ladder to the valve, and with two or three sharp blows bring it back to its proper position, and off go the engines again—just in time, as two or three tremendous rolls give warning that the ship is just on the point of losing steerage-way. All this has taken about thirty seconds, though it seems much longer, and the rest of the engineers, who, aroused by the stoppage of the engine and the roar of escaping steam, have risen from their bunks, drop back on their pillows with a sigh of relief.

"How's things working?" asks the engineer of the junior, as they both descend to the lower platform.

"Low, pressure go-ahead guide working warm. I have given the greaser extra oil for it, all the rest working well."

"Guide dangerous?"

"Not yet, but it's not getting cooler."

"How's the thrust?"

"Keeping just the same."

"All right. Watch that guide well, and let me know if it gets any hotter," and away he goes into the stoke-hole.

The firemen are still toiling away and trying to keep up steam, but the work is beginning to tell, and now and then one walks into the engine-room and takes a wistful glance at the clock, which, to the nearly worn-out men, seems to move slower and slower towards the welcome eight bells. Four hours' work at the fires of an Atlantic racer tells on the strongest men, even in fine weather, and when the labor is increased by the rolling and pitching of the ship in a heavy sea, almost passes the limit of human endurance.

But letting the steam get low is a crime not soon forgiven by the chief, and the engineer drives and urges on the firemen, who go round the fires with rake, slice and shovel till the sweat pours off them in streams.

"Coal! coal!" The coal is being used up faster than the trimmers are bringing it out of the bunkers, but, urged on by the shout, two or three trollies shoot out from a small dark alleyway, pushed by men as black as the coal itself, who duck their heads as they dive after their trollies through the low passage between the boilers, and discharge their loads in the center stoke-hole, while some invisible agency shoots heaps of black diamonds out of the bunker doors on the plates of the end stoke-holes.

As the steam rises, the engineer passes into the engine room, and nearly runs into the arms of the junior, who is just coming for him.

"What's the time?"

"A quarter past eleven."

"How's the guide?"

"Worse and worse—will not cool without water."

Together they proceed up to the grating, where the greaser stands close under the cylinder, throwing huge splashes of oil from a large can on the guide, as the "crosshead" descends at every stroke—but the guide is too hot, and each time the slipper passes over its surface, is left as dry as the inside of an oven. Putting out his hand, the engineer lets it rest for a second on the polished surface, but instantly snatches it back, smarting and nearly blistered with the intense heat.

"Put on the water."

The greaser passes the oil can over to the junior engineer, and runs to the store, reappearing with an india rubber hose. He screws one end on the water-service pipe passing up the column of the engine, and ties the nozzle to an eyebolt under the cylinder, so that a small stream of water runs down on the hot guide, and is thrown off in scalding drops by the "crosshead" as it rushes up and down with every revolution of the engine. The greaser is sent off to look after the rest of the engine, and the junior, having made a mixture of oil and sulphur, makes dashes every few seconds into the scalding shower, with a long-handled tar brush, with which he applies the mixture to the "guide."

The senior, who has gone into the stoke-hole to urge on the firemen, again appears on the platform below, and shouts up, "How's she doing now?"

"Getting worse."

"Well, it's a quarter to twelve now, call the watch, and then fetch the chief down to that confounded guide."

"All right!" and coming out from under the cylinders, drenched through and through with water and oil, the junior goes up to call the third engineer's watch, and then round to the chief's cabin. He finds that gentleman sitting in a chair in his shirt and trousers, pulling on a pair of boots, and listening to the roar of the engines below.

"What's that water on for?" is his first question, as the junior appears at his door.

"Low-pressure guide hot, sir."

"Can't you cool it without water?"

"No, sir, water's been on twenty minutes and it's getting worse."

"How are the intermediate crank-pin and thrust?"

"All right, sir."

"Everything else all right?"

"Yes, sir."

"All right!" and off goes the junior below, as fast as the rolling of the ship will allow him—now going a few steps down the ladder, as the ship lays over to port, and then clinging to the hand-rails, to save himself from being pitched headlong to the bottom, as she swings the other way. The senior, who has taken his place on the gratings during his absence, now relinquishes the "swab-brush," and goes below to prepare for the relief. In a few minutes down comes the chief, and looks at the guide—one look is enough. The way the polished surface is left dry and almost smoking at every stroke shows him that, were he to lay his hand on it for the twentieth part of a second it would leave a blister, and without delay comes the order:

"Call the second!"

As the junior departs to obey, eight bells sound from the deck—just heard above the rush of the wind over the skylights; and eight strokes, sharp and clear, reply from the engine-room. Before the sound has died away, the third engineer and his watch are half way down the ladder to give a welcome respite to their predecessors, and the junior sighs, as he reflects that he must stay below till the hot guide is cool, as it now needs so much attention that the engineers on watch cannot look after it and the engine at the same time. Again descending with the second, he finds the guide beginning to smoke, and the water, turned on full by the chief, coming off in clouds of steam.

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* A "slice" is an iron bar eight or nine feet long, and flattened like a chisel at one end, which is used for breaking up clinker.

"Here, Mr. Smith!" shouts the chief, as the second makes his appearance, "fetch that spare hose, and bring the water from the intermediate guide service."

The eight to twelve watch being relieved, all go off with the exception of the two engineers; and the senior follows the second to the store, returning with a second india-rubber hose, which they attach to the service pipes on the intermediate engine, and lead over to the low-pressed engine, where the junior, seizing the nozzle, turns it full on the vertical surface of the guide, which now begins to show sparks and a dull red band down the center, which gets brighter and brighter, and slowly grows broader and broader every time the cross-head rises and falls, and the slipper passes over the glazed surface.

On goes the water, and, as it strikes the heated surface of the guide, throws off clouds of steam, through which loom the figures of the two engineers, standing in a shower of scalding water, every drop of which gives a sharp and stinging smart as it penetrates to the skin, and now and then causes them to shrink back, with a muttered imprecation, as a hotter shower than usual falls over them.

Behind them stands the chief silently holding on to the hand-rails, the heels of his boots jammed against the bars of the gratings on which he stands, to keep him steady, as the ship pitches and heaves; and the second moves round, giving directions to the storekeeper to keep the oil-pots (out of which the "fourth" is "swabbing" the guide) full, now and then shutting off the water, to get a better view of the guide, and turning it on again, and occasionally taking the place of one or other of the engineers, as, almost blinded and suffocated by the splashing water and the fumes from the oil, they retreat from under the cylinders to rub their eyes, and wring some of the water out of their wet clothes.

Minute after minute passes, and the minutes crawl into long hours, and still the engineers work on in their fierce fight against the powers of Nature—their eyes tingling with pain from the hot salt water and burning oil—their bodies swaying backwards and forwards with the rolling of the ship, holding on with one hand, while they direct the water and apply the oil with the other jarred through and through every few minutes, as —the propeller being lifted out of the water the engine makes an effort to "race," and shakes the grating on which they stand, as if it had been made of aspen wands instead of solid iron, while the steamer gives a tremble throughout.

The passengers in their berths sleep on, or, if kept awake by the rough weather, wonder vaguely how long it will last, and then turn over and try to go to sleep again, in blissful ignorance of all that is going on below.

Hour after hour goes slowly by—and, as the morning approaches, the weather moderates, and the ship becomes steadier. But, in spite of all the water poured on it, the guide will not cool down. The enormous friction produced by the high speed of the engine keeps up the heat; and although the water poured on has slightly reduced the temperature, it fails to bring it down to the normal degree. The only cure will be to slow down the engines, but slowing down is the very last resource on an ocean racer nowadays, when the Atlantic trip is so accurately timed that one boat often beats the record by a few minutes only, and no engineer would run the risk of losing the place gained by his ship, by slowing down, as long as he can *safely* keep at full speed.

Four o'clock comes, and as eight bells again strike, the third engineer's watch is relieved by that of the second—the third only remaining below to take the second's place while the latter looks after the guide.

The chief goes on deck for a few minutes, but presently returns. "Any cooler?" he asks the fourth.

"No, sir."

"Slow her down, Mr. Smith"—the order comes reluctantly from him at last.

"All right, sir;" and the second descends to the lower platform, sends the third to shut the dampers, and as the steam drops a pound or two, half shuts the throttle-valve. As the three huge cranks gradually ease down to half speed, the sudden lull in the continuous roar of the engines is almost painful to the ear, and the beat of the valves and clank of moving masses resolve themselves into distinct noises, while a long-drawn squeal comes from the hot guide, which now rapidly cools down under the reduced friction and copious streams of water.

The electric lights are beginning to pale, as a dull gray dawn shines through the skylights. The second being now free to attend to his watch, sends the third up to his cabin, and presently, the guide having greatly improved, the engines are once more put at full speed, and as it continues to get cooler, the chief at length goes off to bed.

The water is kept on for some time longer, after it is shut off the two engineers by turns continue to swab the guide with oil and sulphur. It is nearly eight bells before the second at last declares the guide, "safe," and they crawl on deck to get breakfast and a few mouthfuls of fresh air before beginning a fresh watch.

As the bell strikes they once more go below, to drag on through another weary four hours, when they are so tired that lifting their limbs is painful, and quick motion an agony. Yet, in moving round that engine and feeling its brasses and rods, should a man hesitate one instant in withdrawing the arm stretched out to test that piston-rod, it would be shattered or rendered useless by a merciless blow from that mighty, remorseless engine which it can control like an obedient child.

At noon the fourth watch is relieved by the third, and the two tired-out engineers at last get a respite, after nearly sixteen hours in the engine room. At four the second watch takes the place of the third, till eight, when the fourth once more comes on, and so, unless something is wrong, it goes on day and night in unvarying monotony, till the ship passes Sandy Hook, steams slowly through the Narrows, and swings into her berth alongside the jetty at New York.

"And then," innocently remarks a passenger, "your fun begins."

"Does it?" queries the engineer to whom he is speaking. "Well—yes—if completely overhauling that engine in five days is fun, our fun does begin."

"Overhauling the engine! why, what on earth is wrong with it? It is working all right, and has been since we left Liverpool."

"Yes, but it has to work right all the way back," is the reply, and the passenger, not caring to exhibit any more ignorance, walks slowly away.

Yes, everything has to work right all the way back, and nothing is left to chance. Every day, from morning till night, and sometimes on into the night, the engineers are at it, cleaning the boilers and examining every working part of the engine, to make sure that nothing is wrong or likely to go wrong in the coming run across the Atlantic. It is only by unremitting care that the huge engines of our modern mail steamers can be kept in good order. Now is the chance for a quick passage.

It is a hot day in the middle of summer, the sea rolling in long, smooth, oily swells. There is a light breeze right astern, but the ship is steaming as fast as the wind, and the sails hang listlessly from the yards and flap against the masts and ropes. As one descends the engine-room ladder, the air feels close and deadly heavy, and brings on a dull headache. The engineer on watch is dragging himself round as if his limbs were of lead, and even the engines do not seem to be going ahead with their usual energy. As we pass through the tunnel which connects the engine-room with the stoke-hole, the stifling atmosphere nearly drives us back. There is not a breath of air coming down the ventilators, and the heat is so great that one has a sensation as of a lump of lead in the ears, and one's voice sounds thick and far away.

The firemen are stripped to the waist, and the engineer has very little more on, being only distinguishable by the gilt band and badge on his cap, as he moves about from one furnace to another, directing the firemen, or regulating the water in the boilers.

In spite of the heat, the fires burn dull, for they can get no air, and the firemen, urged on—one might almost say driven—by the engineer, are doing "all they know," with rake and shovel, to keep up steam, the perspiration running in streams down their coal-begrimed bodies, and leaving them striped like zebras.

Each man in turn falls back exhausted, and is succeeded by another, who lays hold of the heavy "slice," and works the fire through and through; but all to no purpose, for in spite of all they can do the steam will not rise. In technical language, "she is steaming stiff," and, unless the wind changes, or gets stronger, will continue to do so.

To keep on at this work without drinking is impossible, and the firemen consume an incredible quantity of water; but, in spite of all the praise bestowed upon this beverage by teetotallers, its has its dangers when drunk to excess, especially in a high temperature, and presently one of the men, who has been indulging too freely, is seized with cramps in the stomach, and has to be carried on deck, leaving the rest tearing away at the obstinate fires.

Now and then one goes up to lay his throbbing head on the deck, gasp in a little fresh air, and, if possible, gather a little strength before once more attacking the fires in the awful den below. The forward stoke-hole is even hotter than the others, and the heaps of coal and ashes lying about, the sudden glare, as furnace doors are opened and again shut, the trollies of coal pushed out of the bunkers and returning empty, the ash-buckets passing up and down the ventilators as the ashes are hoisted on deck to be thrown overboard, the rattle of lumps of coal on the iron floor-plates, the clang of furnace doors and fire-irons, and seeming general confusion, make one wonder if Dante would not have used the stoke-hole of an Atlantic liner—had he known of such a thing—to illustrate his "Inferno."

The fires here are as bad as the others; they will not burn well, and the engineer and two of the most hardened firemen are trying to raise the steam by working the coal about. The former flings open the door of the first fire, and holds up the iron shield to keep back the fierce glare, while the first man pushes in the heavy slice and rakes the fire through, sending a shower of glowing ashes down through the fire-bars into the ash-pit. Two minutes' hard, tearing work, and the man steps back almost exhausted, the shield is withdrawn, and the second man, advancing with a shovel into the full glare of the mighty fire, heaves on load after load of coal, till he has covered the glowing mass with a smoking layer of fresh fuel, and then bangs to the door.

But slicing fires soon tells, and the first man obliged to knock off work goes on deck for a few minutes to try and pick up his strength in the fresh air. Down goes the shovel as the second man seizes the abandoned slice and attacks the next fire, for the least pause at once shows itself on the steam gauge. The engineer, too, is almost done up, but there is one more fire to be cleared and filled. As the fireman drops the slice for the shovel he calls up another man.

"One more, my hearty—give her fits and make her sing!"

The fire is raked, the slice withdrawn, and the man staggers back.

"Now, my hearty, fill her up!"

On goes shovel after shovelful of coal—first right to the back of the fire, then nearer and nearer to the front—till the glaring white-hot mass has a black top, off which the smoke rolls in clouds.

"That's it—let her rip!"

The last load is pitched on, bang! goes the fire-door, the shovel falls from the man's nerveless hands, and utterly done up and exhausted, he drops on the iron floor-plates, and vomits like a dog.—*J. F. Werner, in Contemporary Review.*

OVERHEATED BOILER PLATES.

Joints in the Fire.

Some very interesting experiments to determine the effect of rapid evaporation on fast steaming boilers, such as those used in steam fire engines, torpedo boats, etc., have been tried in France, by M. Hirsch, which, so far as experiment can establish certain facts which it is of interest to know.

Overheating occurs when a sheet becomes red hot over a portion of its surface. The circumstances which cause overheating are not well determined. If heat is transmitted through a metallic plate in contact with water on one side, it seems difficult to cause overheating on the other side so that the hypothesis of low water is usually advanced. Really, in a case of this kind, there are three points to be considered: The rate of conduction of heat to the plate, the rate of heat transmission through the plate, and the rate at which the plate imparts its temperature to the water. It seems certain that under ordinary conditions, the external surface of the sheet has a much lower temperature than the fire or products of combustion in contact with it, and that the interior surface has a temperature not much greater than that of the water in the boiler; so that the most serious obstacle to the transmission of the heat to the water is the resistance of the plate.

Three sets of experiments were made:

1. Evaporative tests at portions of the boiler exposed to direct flame.
2. Experiments on the transmission of heat through the boiler-plates and from the plates to the water.
3. Examination of the effect of scale and grease.

The evaporation of a boiler is frequently measured by the hourly rate in pounds per square foot of heating surface, but this only gives the average result, while the rate of evaporation varies greatly for different portions of the heating surface. Experiments made with a locomotive boiler on the Northern Railway of France, the boiler being divided into several sections, showed a rapid decrease in the rate of evaporation as the distance from the furnace increased, so that the tubes at their extreme ends scarcely evaporated any water, at moderate rates of combustion. The furnace sheets and a small portion of the contiguous tube surface, forming the first section, evaporated at the rate of 44. 6 lbs. of water hourly per square foot of heating surface.

It seems certain that the only parts where overheating is to be feared are the furnace and adjacent surfaces, and if a boiler is forced to a dangerous extent, and the tubes are lengthened without reducing the rate of combustion or making any other change, the average rate of evaporation will be diminished, without in the least diminishing the danger to overheating of the surfaces exposed to direct flame.

In Hirsch's experiments the amount of heat transmitted by the plates over the bridge-wall was measured in a stationary boiler set in brick. A metallic cylinder was fastened to this plate, isolating a surface of about 16 sq. in., and the evaporation in this cylinder was measured by a glass gauge suitably disposed.

A large number of experiments were made, burning coal at various rates, from 16.4 lbs. to 48.7 lbs. hourly per square foot grate surface, and giving evaporative rates varying from 16.4 lbs. to 50.2 lbs. per square foot hourly. The average hourly rate of evaporation, measured for the total heating surface of the boiler, varied from 9.6 lbs. to 19.3 lb. per square foot. These rates of combustion and evaporation are largely above the ordinary practice with stationary boilers, and the author concludes that the hourly rate of combustion per square foot of grate surface, in boilers of the type used in his experiments, ought not to exceed 28.5 lbs.

In the second series of experiments, a wrought-iron plate was subjected to intense heat on one side, the other side being in contact with water, and measurements were made of the quantity of heat passing through the plate, together with the temperature of its external surface.

A circular sheet of wrought-iron about 16 in in diameter and $\frac{1}{4}$ in. in thickness was attached to a copper cylinder, forming an open-topped boiler and set in a furnace of fire clay. Heat was applied by a large blow pipe, burning gas with a blast. The evaporation was measured by weighing the amount of distilled water which it was necessary to introduce for the purpose of maintaining the water level constant. The temperature of the plate was measured indirectly by preparing fusible alloys whose melting points were known, and placing plugs made of these alloys in holes bored in the plate. After each experiment, the bottom of the boiler was examined, and some of the plugs being melted while others were intact, the limits between which the temperature of the plate had been maintained could be approximated. The melting point of the alloys was checked by experiment for those which melted below 572° F. Above this point lead and zinc were used, estimated to melt at 634° and 842° respectively. These temperatures, especially the latter, are somewhat uncertain.

The water evaporated by this apparatus was reduced to equivalent evaporation at 212° from feed at 32° F. per square foot of surface hourly, which is called the *evaporative rate*. The following is a summary of the results obtained:

As the evaporative rate increases, the difference between the temperature of the external surface of the plate and the temperature of the water on the other side of this plate rises progressively. The difference for an evaporative rate of 41 lbs. is 212°, and does not exceed 302° even when the evaporative rate is increased to the high figure of 61 lbs. This is an important and reassuring fact showing that even with very high evaporative rates the temperature of the external surface of the plate can never exceed 536°. Hence it does not seem probable that there is any danger, in practice, of overheating a boiler-plate in an unbraced or unthickened part, if the metal is sound and well moistened with water. But danger may exist if for any reason there is any obstruction to the transmission of heat, either through the plate or from the plate to the water.

The preceding experiments were made with distilled water. They were repeated, using water thickened with starch. Two sets of experiments were made, one with water containing 0.002, and the other with water containing 0 005, by weight, of starch.

With water containing 0.002 of starch, the temperature of the external surface of the plate was increased about 27°.

Water containing about 0.005 of starch is much thicker, and its ebullition is much more violent. The temperatures of the plate were but slightly increased above the preceding. This quantity of starchy matters is rarely used to remove scale, so that the use of starch does not seem liable to cause overheating.

Several experiments were made after covering the plate on the interior surface with thin coats of plaster of Paris. For a thickness of 0.04 inch, the temperature of the external surface was about 54° higher than was found for the plate in direct contact with distilled water. Coating the plate to a thickness of 0.2 inches, its external surface had a temperature of 450° for an evaporative rate of 32 lbs., and a temperature of 720° for an evaporative rate of 41 lbs. These figures are, respectively, 63° and 378° above the temperatures obtained with clean plate in contact with distilled water. They show clearly the bad effect of incrustations.

To determine the effect of changes in the thickness of a plate, due to seams or deposits, a sheet of steel, 0.2 in. in thickness, was soldered to the plate. The temperature of the external surface of the plate was increased 90° for an evaporative rate of 21 lbs., and 126° for an evaporative rate of 61 lbs. over the temperature obtained with the plain plate. This seems to indicate that there is danger in exposing riveted seams to the contact of an intense flame. Experiments made with a double bottom, having mica interposed, showed that for an evaporative rate of 32 lbs., the temperature of the plate exceeded 630°, and that for an evaporative rate slightly greater, the temperature exceeded 842°, indicating that overheating was imminent. This is a clear proof of the danger of deposits in the vicinity of the furnace.

Mr. Hirsch draws the following conclusions from his experiments:

1. A sound and continuous sheet, in contact with water on one side, never acquires, however intense the fire may be, a temperature sufficiently high to sensibly decrease its strength.
2. The viscosity of the water, even when considerable, does not lessen its refrigerating action.
3. The transmission of heat is more or less affected by riveted seams, and such seams should not be exposed to an intense fire.
4. A diminution of thickness in a plate caused by a flaw or crack, or a lack of close contact between two plates at a seam, is a grave cause of danger, even with moderate fires.
5. The contact of the masonry setting even at a very high temperature is not dangerous if the plate is continuous and in contact with water on the other side.
6. Any grease or oil on the internal surfaces is a serious obstacle to the transmission of heat.
7. When the oil or grease is decomposable by heat, overheating is particularly to be feared. The organic oils, linseed, rapeseed, etc., appear to be more dangerous in this respect than the mineral oils.

Finally, it may be concluded that a boiler, well set, carefully managed, clean, and containing a full supply of water, is not liable to be burned, even with an intense fire, but that with rapid combustion it is essential to take proper precautions for the purpose of avoiding anything which might interfere with the transmission of heat through the metal and from the metal to the water.

CLASSIFICATION OF COALS.

The accepted basis of classification of coal ranks it according to its fuel constituents, or, more definitely, according to the ratio between its fixed carbon and its volatile hydrocarbons. On this the following scheme has been offered:

Classes of Coal.	Fuel Ratio=$\frac{\text{Fixed Carbon.}}{\text{Volatile Hydrocarbons.}}$
Hard dry anthracite	From 99 to 12
Semi-anthracite	From 12 to 8
Semi-bituminous	From 8 to 5
Bituminous	From 5 to 1

This has been used in classifying Pennsylvania coals, but even there it cannot be made to regulate trade distinctions. Coals which, according to this method of classification, are semi-anthracite, are classed in the trade as anthracite, and coals which by composition are bituminous, are classed as semi-bituminous. The practical objection to this is that it distinguishes coals entirely according to their proximate composition, whereas in the trade the action of the coal in its various uses is the distinguishing property; it is a fact that the coals of the same proximate composition will, owing to some inscrutable details of composition, yield different results in practice. The following expresses in a condensed form the general meaning in the trade of various terms applied to coal:

Anthracite coal is characterized by a low percentage of volatile matter, high specific gravity, hardness, nearly metallic luster, and semi-conchoidal (shell-like) fracture. It ignites with difficulty, produces an intensely hot fire, gives off no smoke, and burns with a very small blue flame which disappears after thorough ignition. Fragments of this coal retain their shape until consumed.

Semi-anthracite coal is not so dense nor so hard as anthracite; the percentage of volatile matter is greater, and the fracture often approaches the cuboidal. It ignites more readily than anthracite, and burns with a thin yellowish flame which disappears on thorough ignition. Fragments change their shape very little or not at all during combustion.

Semi-bituminous coal is less dense, and has a higher percentage of volatile matter than semi-anthracite. Fracture cuboidal. It ignites easily, burns with a yellow flame, and swells or cokes to a certain degree during combustion. Bituminous coal is characterized by a low specific gravity, and is brittle, with a cuboidal fracture, bright resinous luster, and a high percentage of volatile matter. It burns with a long yellow flame, giving off more or less smoke. It is usually quite soft, and generally swells, fuses, and cokes in the fire. Coking coal swells and fuses in the fire, and, when air is excluded, the gaseous products are driven off, leaving the carbon in a coherent, porous mass. A coking coal is a caking coal. Cannel coal is firm and compact with homogeneous structure; brown to black in color with a dull resinous luster. It kindles readily, burns without melting with a dense smoky flame, and splits in the fire. It breaks in all directions with no particular lines of fracture. It is an excellent gas coal, and is rich in hydrogen. It contains 40 to 50 per cent. of volatile matter, and only a low percentage of moisture. Lignite or brown coal is a link between peat and bituminous coals. It is compact or earthy, sometimes woodlike in appearence, with a conchoidal or uneven fracture, and may be either cleavable or uncleavable. Its color is light yellow, light gray, brown, brown black, or black with a dull shining or fatty luster with a specific gravity from 1.2 to 1.4. It is generally fragile and combines readily when exposed to the weather, and contains a large amount of moisture, varying from 10 to over 30 per cent., and consequently yields only a moderate heat. It kindles readily and burns freely with a yellow flame and comparatively little smoke. Generally it is non-caking. The percentage of volatile combustible matter varies from 25 to over 40, and its fixed carbon from 30 to over 50. —*Report of Arkansas Geological Survey.*

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RACING OF MARINE ENGINES.

THE injurious effects of racing are felt throughout the whole engine and its fittings. T. G. Barron, who speaks from long practical experience at sea, says: "When an engine attains suddenly a speed of double the number of revolutions per minute at which it is intended to run, and is as suddenly brought up to its normal rate, it may be said to be racing, although very much worse racing than this is common enough; and the whole strain of the sudden check to the engines, caused by the extra resistance offered by the water to the propeller as it dips, after being partially or wholly lifted out of the water, must necessarily be transmitted through the shafting and coupling bolts from the propeller shaft to the crankshaft. If the governor is quick enough to check the racing before the propeller is again immersed, the twisting strain to the shafting will be avoided, or at least greatly reduced. There is also a severe straining to the pumps, pump rods, and links, caused by the racing, the pumps being unable to deliver the water quickly enough; and the bucket valves coming down heavily on the surface of the water put extra weight on the rods and other gear, as well as destroying the valves. The feed pumps being only partially filled with water, and the rams coming suddenly in contact with it give a shock to the barrels of the pumps, and also to the pump crosshead, etc., which is not the case when running at their normal rate. A continuance of this vibration loosens the foundation plate of the engine, and in fact it would be difficult to say where the evil of racing ends.

Only quite recently we have had reports of serious damage having been done by racing to the pump valves, condenser doors, etc. In one case the condenser doors were cracked, and the main steampipe caused to leak, necessitating the stoppage of the ship at sea for repairs, generally a very difficult and dangerous operation. Amongst other very serious results of racing is the loosening and frequent fracture of the stern tube and bush, and damage to the hull caused by excessive vibration; also the great alarm it causes on board passenger steamships, a serious consideration, though it has neither a mechanical nor economical bearing. There is also the prejudicial effect of vibration, such as that produced by racing, on the chronometers and compasses. This is confirmed by the leading makers of these instruments. If an ungoverned engine gets away, which it may easily do, to three or four times its normal speed, it will cause considerable agitation of the water in the boiler, materially facilitating, if not actually causing, priming, especially in boilers so inclined, thereby incurring the risk of serious damage in the steampipes by waterhammering, and breakages in the cylinders. The condenser is liable to become overheated, owing to the circulating pumps not working efficiently at racing speeds, causing partial or total loss of vacuum when the full power of the engines is required, danger of leakage, and breakdown of condenser through undue expansion and contraction. These difficulties can only be overcome either by throttling (wire-drawing) the steam, or else linking the engines up, in both of which cases there is a material loss of power and speed, which can almost entirely be avoided by the use of a proper governor.

It is sometimes stated that even if triple engines do race, it is not as objectionable as with two-crank engines. Such a remark can only apply to one's personal comfort, as accelleration of speed means a considerable increase of wear and tear. All experience proves that under similar conditions a three-crank engine will get away more quickly, and run at a higher speed, than one with two cranks. Granted the three-crank may run more smoothly than a two-crank, and its racing, therefore, would not be so uncomfortably perceptible; but all other objections and risks remain, and, if anything, are increased.

While compound engines were in vogue, there was hardly an engineer but who insisted on having them fitted with reliable governors; but since the introduction of the triple-compound engine, an idea seems to have got abroad that they do not require governors—why or wherefore it is difficult to explain.—*J. D. Churchill.*

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ON THE MOST ECONOMICAL ENGINE FOR SMALL POWER.

A CERTAIN machine shop possesses two steam engines; one a plain slide valve throttling 5½ inch bore by 7 inch stroke, the other an automatic cut-off 7 inch bore by 14 inch stroke, both non-condensing. The shop required 7 horse-power to run it, exclusive of the power to overcome the friction of the engine. The question arose whether it was cheaper to run the shop at 70 pounds boiler pressure with the plain slide-valve engine cutting off at three-quarters, or with the 7 inch by 14 inch engine cutting off at one-fifth under the automatic action of its governor, or whether fuel would be saved by operating the engines on the compound principle, using the small engine as the high pressure cylinder and exhausting from it into the larger engine through a receiver, the system still being non-condensing. Both engines were carefully overhauled and made perfectly tight at their valve seats and pistons. Each engine was then tested to determine the power absorbed to run itself, with the result that the small engine consumed $\frac{6}{10}$ horse-power and the large engine 2½ horse-power. The small engine was then made to perform 7¾ indicated horse power at 70 pounds boiler pressure and 146 revolutions per minute, the exhaust escaping into the atmosphere at a back pressure of 17 pounds. The steam consumption per hour per horse-power was 45 pounds. The large automatic engine was then made to perform about the same indicated horse-power at the same steam pressure and revolutions, the cut-off being about one-fifth. The steam consumption per hour per horse-power was 35 pounds. The same work was then performed by operating the engines on the compound system at the same boiler pressure and same cut-off in the small engine and with 26 pounds receiver pressure and about one half cut-off in the larger engine, the exhaust passing into the atmosphere from the larger cylinder. The ratio of the two cylinders made the ratio of expansion 4⅓, including clearance, or practically the same as the real ratio of expansion when the large engine was used alone, the clearance of the latter being 5 per cent. The steam consumption per hour per horse-power was 33 pounds. It follows from these results, that to obtain the 7 net horse-power required to operate the shop the indicated horse-power for the three methods would be as follows:

System.	Friction.	Net Work.	Total or Indicated H. P.
Small engine.......	.6	7	7.6
Large engine.......	2.5	7	9.5
Compound engine..	3.1	7	10.1

The expense measured in steam consumed per hour will therefore be as follows:

Small engine, 7.6 by 45 equals 342 pounds.
Large engine, 9.5 by 35 equals 533 pounds.
Compound engine, 10.1 by 33 equals 333 pounds.

It is evident that so far as the coal consumed is concerned the three methods are practically equal. The best method will, therefore, be the one which gives the least wear or tear or the least trouble to apply, the first cost being too small in both cases to make interest a sensible factor. This makes the most economical method that which derives the required power with the large engine alone, as the load upon it is only about half its working capacity, and, consequently, the wear and tear is very light, and, as a matter of fact, the engine has done the work for years with far less attendance and repairs than would be required if the small engine was made to perform the required work. It is worthy of note that the greater proportional power required to overcome the friction of the automatic engine is due to the fact that its main shaft and flywheel, which cause the greater part of the friction, weigh much more in proportion to the total mean pressure on its piston than is the case with the small engine.—*Prof. Denton in The Indicator.*

◆

THERE is a method of finishing cast iron in a lathe, we believe more known by German workmen than others, which consists in starting up the piece at a tolerably high speed, and taking a very light cut with a thin spring tool and a coarse feed. It is worth knowing, and is certainly of much use when once learned. It corresponds to the thin hand scraper commonly used on cast iron. We have seen it done here in San Francisco very successfully.—*Industry.*

TRADE NOTES.

The contract for the construction of the lighthouse tender '*Marigold*,' for the great lakes, has been awarded to the Detroit Dry Dock Company at $77,000.

⁂

An inventor has devised a method of expanding wheel tires by heating them with electricity. It is claimed that the heat is more uniformly distributed than with gas furnace or piles of embers. The current is brought by wires connected to opposite points on the tire and divides equally through each half of the ring.

⁂

The Columbia Aluminum Company, chartered in Virginia, $3,000,000 capital, proposes to establish works in Washington, D. C., for extracting aluminum from North Carolina clay by a process invented by Julius Emmner, Jr. It is explained that the operation is by "combined electricity, fusion and distillation," and it is claimed that the cost will not exceed 25 cents per pound of metallic aluminum, 96 per cent. pure.

⁂

The Chicago Shipbuilding Company, recently organized for the purpose of building steel ships at Chicago, has closed a contract with the Minnesota Steamship Company, for two boats to cost about $210,000 each. The Minnesota Steamship Company is the Minnesota Iron Company of Tower, and with the close of this deal will have six boats for the trade, four of them having been contracted for at Cleveland a few months ago. The Chicago Company will begin work as soon as the new yards can be put in shape. All of the boats will be duplicates, 292 feet keel, 308 feet over all, 40 feet beam and 24½ feet hold.

⁂

Many of the engineer officers of the navy are resigning to accept positions in civil life. This is due to the development of the shipbuilding interests in this country. Engineer officers of prominence in the navy find that their services are in demand by contractors who are making a business of furnishing the new warships with engines and boilers. It is said that Samuel Moore & Son, of Elizabethport, N. J., have induced an engineer officer of prominence to resign and accept a position with them of Superintendent of Machinery Construction. They have secured the contract for the Naval Academy practice ship and one of the 1,000 ton cruisers.

⁂

The Automatic Phonograph Exhibition Company of New York City was lately incorporated in the Secretary of State's office with a capital stock of $1,000,000. It is formed to manufacture, lease, use, and sell a nickel-in the-slot machine, by means of which the dropping of a coin in the slot will operate a mechanism which will cause a phonograph or phonograph-graphophone to produce the sound recorded upon its cylinder, and after such reproduction cause the diaphragm to return to its original position. The Trustees of the company are Felix Gottschalk, Willard L. Candee, Thomas T. Eckert, Jr., Richard W. Stevenson, Victor E. Burke, John E. Prague, and James Molinari.

⁂

A new steamboat company, known as the Seabright and Pleasure Bay Steamboat Company, was organized recently, with the following officers: President, Capt. A. H. West, Seabright; Vice-President, Dr. James H. Patterson, Shrewsbury; Secretary, Dr. William Beach, Eatontown; Treasurer, A .C. Newing, Long Branch. The capital stock of the company is $30,000, and there are twenty stockholders. A steamboat to cost $26,000 is being built at Nyack, N. Y., and will be finished in time to be run next season. The boat will stop at Branchport, Pleasure Bay, Seabright, and the Highlands, and will ply between those places and New York.

⁂

Why does not somebody start a school for the instruction of young men in such practical knowledge as is required in constructing and operating electric plants? Large numbers of persons who would, with fair opportunity, become perfectly competent for such work cannot have the advantage of a college course, and even if they gain an opportunity of learning the business in some electric factory, they are most likely to learn only one system (or small part of one system) and get a prejudice against all others. A station well fitted with a variety of engines, dynamos, and other suitable appliances, a few good instructors in theory and practice, some means of utilizing the surplus energy, and the candidates for positions as electric artisans would be forthcoming. —*Review.*

[There is such a school now.—Eds.]

⁂

The Pittsburg Reduction Company, of which Mr. Alfred E. Hunt is president, now leads the world in producing pure aluminum, and Mr. Hunt and his associates have investigated the nature and qualities of this metal more thoroughly than has ever been done before. At present the monthly production of the works is 1,500 lbs. of the metal, nearly all of which is 98 per cent. pure. During December 2,800 lbs. were shipped, and at present the orders for it are more than double the producing capacity of the works. The company is now greatly enlarging its plant, and has purchased two dynamos of 125,000 watts each, three 208 h. p. Babcock & Wilcox boilers, and two 200 h. p. Westinghouse compound engines. When this new equipment is in place the output of aluminum will be about one ton per week. The office of the company is at 95 Fifth avenue, and the works at Thirty-second and Smallman streets, Pittsburg.

⁂

H. M. Flagler is having a schooner-rigged steel steam yacht built at Wilmington, Del., by the Harlan & Hollingsworth Company. Her dimensions will be about 182 feet, length over all; 160 feet on the load water-line; 24 feet beam, moulded; 13½ feet depth, moulded. She will be fitted with a triple-expansion compound surface condensing engine, the cylinders being 17,28, and 42 inches in diameter, respectively, with 22 inches stroke of piston. Her two boilers will have a working pressure of 170 pounds. The same firm are building a steel schooner for Mr. Frederick Gallatin, of this city. She is to be called the '*Almy*,' and her length over all will be 177 feet 6 inches; on the water line, 155 feet 6 inches; 24 feet beam, moulded; 14 feet depth, moulded. Her engine will be of the triple-expansion type, and compound surface condensing, with cylinders 17, 28 and 42 inches in diameter respectively. She will have one boiler tested for 170 pounds working steam pressure.

⁂

John Ericsson, on March 30, 1880, was granted a patent on a hot-air engine, which he transferred to Mr. George H. Robinson of this city, who assigned all his rights to C. H. Delamater of the Delamater Iron Works, who secured a re-issue of the patent, and proceeded to manufacture the engine. Mr. Delamater soon found that a number of other firms were engaged in the manufacture of Ericsson's hot-air engine, and he began proceedings to enjoin them. Among the manufacturers engaged in turning out the engines were John Weber, A. Flake, E. Bertine, M. Gibline, S. F. Knapp, C. R. Frisbie, H. Rheinhardt, Joseph Granger, and W. H. Harrison. The injunction was asked against all of them, and they made answer that Ericsson was not the original inventor of the hot-air engine, and that it was in use prior to the issue of letters patent to him. Judge Lacombe granted the motion as to the priority of Ericsson's patents, but denied it as to the prior use of the engines.

⁂

Nearly one year ago a prominent official of the Pennsylvania Steel Works, at Sparrow Point, predicted that that great manufacturing enterprise would ultimately include in its business heavy guns and building steel steamships. A Bessemer and rail mill is approaching completion, and now plans are being made by which the Pennsylvania Steel Company will be enabled in the near future to engage in the building of the largest steel and iron steamships. "The first work to be done in the proposed shipyard will be two steamships for the company, to be used in the iron ore trade with Cuba. The huge machine shops, foundry, and pattern shops which are approaching completion have been designed for shipbuilding as well as for present demands. Col. Walter S. Franklin, the superintendent, says that the company would confine itself at first to building coastwise steamships, as the laws of the United States prohibited them from being built in a foreign country, but after a while Sparrow Point would enter into competition with the great ship-building firms on the Clyde."

⁂

Garbage in Buffalo, N. Y., is burned. The process consists in first desiccating it in a cylindrical chest, within which revolves a hollow shaft with hollow arms, into which steam is forced at high pressure. The heat converts the moisture of the garbage into vapor, which passes off through a condenser, where it is converted into water and discharged into the sewer without any offensive odors escaping. In about eight hours the entire mass is desiccated and is then drawn from the receiver. It presents the appearance of a brown powder mixed with rags, bones, and the remnants of tin cans. In this condition it is consigned to another receiver, where it is treated with a fluid composed chiefly of benzine, by which the oily matter is removed. From the second receiver the mass is conveyed to a drying room, where the bones, rags, and tin cans are raked out and removed by hand. The bones are ground, the rags washed, the remnants of tin cans melted, the oily matter refined, and the brown powder mixed with other constituents to form fertilizers. One ton of good coal can be obtained from five tons of ashes.

⁂

Ever since the '*City of Paris*' made the run across the North Atlantic in less than six days, naval constructors have thought more or less of some type of ship that can reduce the record. Prof. Greenhill, of England, declares that in order to build a vessel that will cross the Atlantic inside of five days she must be designed for 30,000 tons displacement, 65,000 indicated horse-power, have a length of 807 feet, a beam of 91 feet, depth of hold 60 feet, and a draught of from 31 to 32 feet. The '*City of Paris*' is of 10,000 tons displacement, and from this some comparison can be made of relative sizes. On the other hand, prominent naval constructors question the practicability of Prof. Greenhill's ideas, and declare that 4½ day ships can be built on the lines of many of the vessels of to-day. The general opinon, however, is that the 4½-day ship must be 700 feet long, have a beam of 70 feet, a draught of 28 feet, a displacement of 19,000 tons, and an indicated horse power of 40,000. The weight of machinery, another engineer says, does not vary as the displacement, but approximately as the indicated horse-power. Another point is the coal consumption. It is gravely questioned whether a 4½-day ship of the above dimensions and horse-power development can carry coal sufficient to last a voyage across the Atlantic. Speculation will continue until actual practice gives us the result.

⁂

The new railway tunnel under St. Clair river at Port Huron, Mich., is over 6,000 feet long. The approaches are equally long, so that the entire length will be more that two miles. Of this distance 2,310 feet are under the river. The grade is 1 foot in every 50, except under the river bottom, where it is substantially level. It is an iron cylinder tunnel—the only one of the kind in the country. There is neither brick nor stone used in its construction. The method of construction is simple. A great cylinder, weighing more than 60 tons, 20 feet in diameter and 16 feet long, is driven into the blue clay, which constitutes the entire bottom of the river, by the use of hydraulic power. Inside this cylinder, twenty-two men are at work removing the dirt. As fast as the shield is pushed forward, which is about two feet at a time, the clay is dug out to the edge of the great cylinder. Then the hydraulic jacks are again started, and the immense iron tube moves another two feet into the solid earth. Each jack has a power of 3,000 tons, and the combined power behind the shield is more than 400,000 tons. Another ring of lining is put into place, and each foot of tunnel is ready for track-laying as fast as the work progresses. There is no mason work, and when done, the tunnel will practically be a continuous iron tube 20 feet in diameter and nearly 7,000 feet long. The iron plates that form the lining are of such curvature and length that any thirteen of them, with a small key-piece, will make a circle of 20 feet in diameter. The edges and ends are turned up, each piece being bolted by a dozen large bolts to its neighbor. Each one is 18 inches wide and weighs 1,000 pounds. These great sheets are handled with cranes so readily that a complete circle is put up in about half an hour. The lining is about 6 inches thick, so that there is no danger of collapse from pressure.

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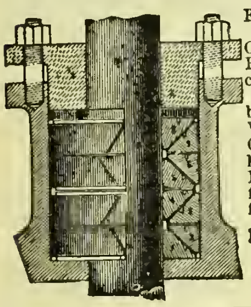

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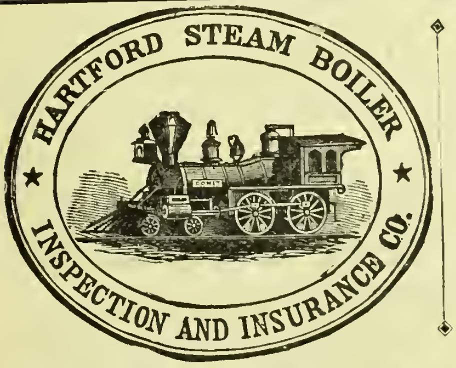

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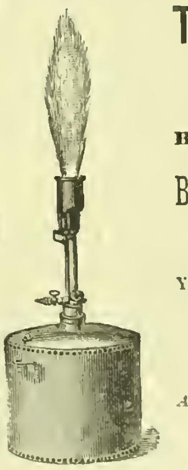

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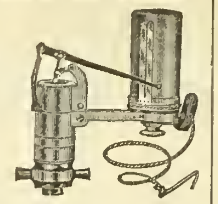

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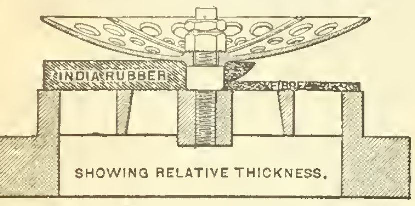

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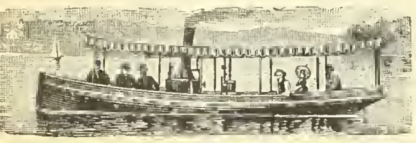

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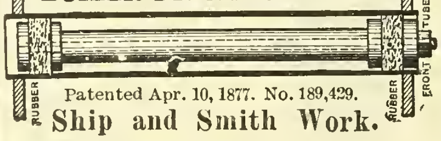

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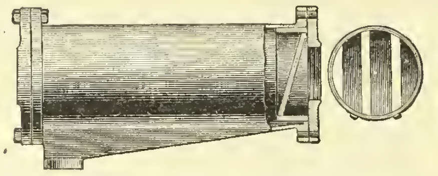

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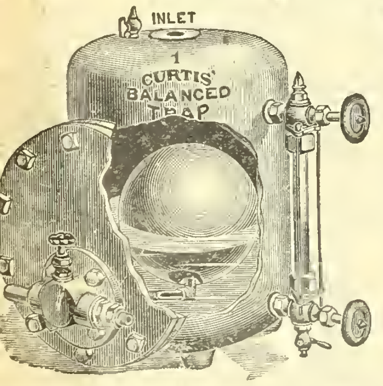

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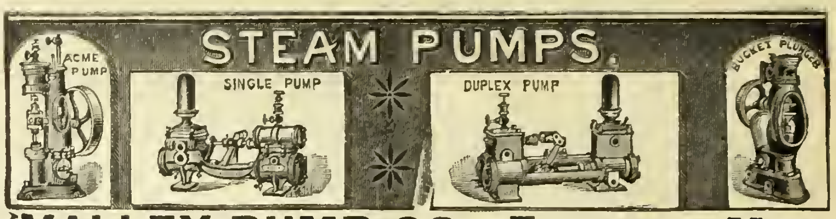

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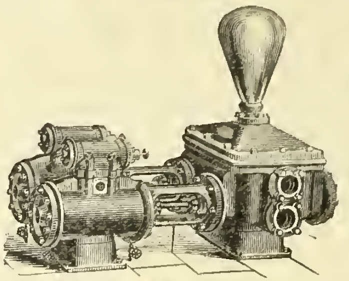

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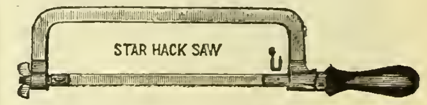

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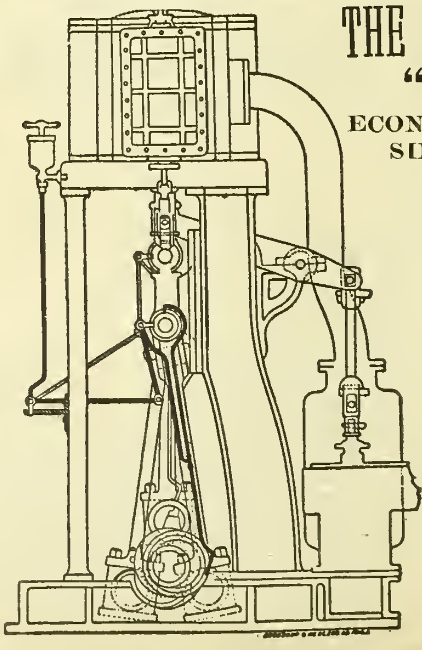

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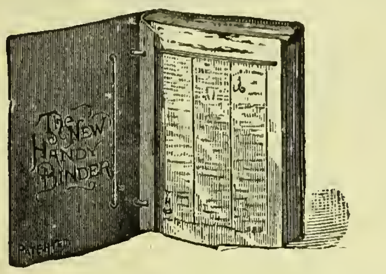

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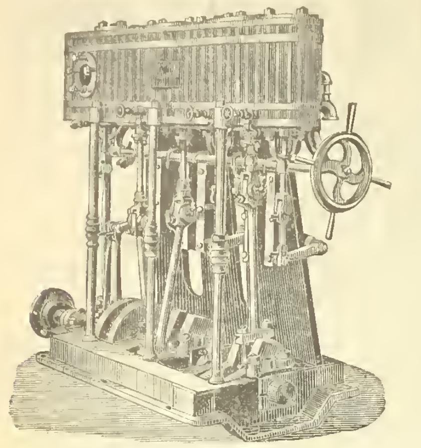

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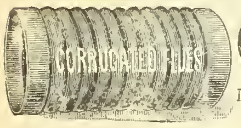

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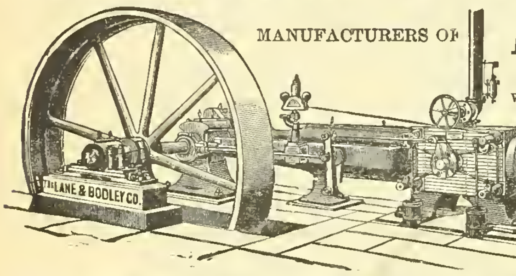
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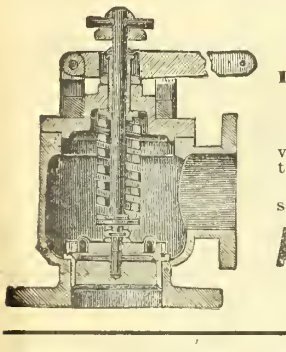

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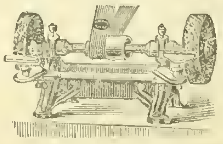

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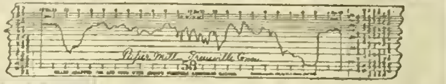

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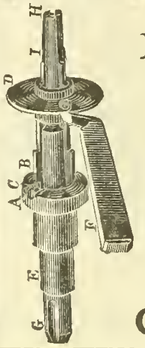

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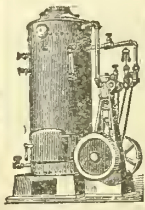

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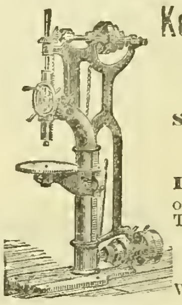

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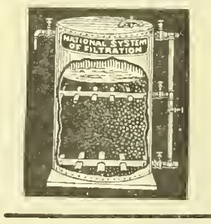

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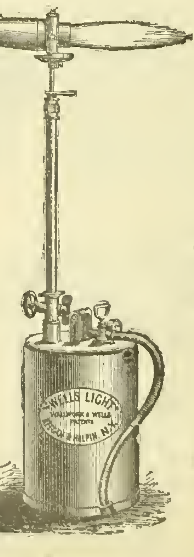

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Ninth Year of Publication.
STEAM ENGINEERING, APPLIED MECHANICS, AND THE ALLIED ARTS.
$2.00 per Annum. - Single Copies, 8 Cents.
March 1, 1890.

THE ROBERTS WATER TUBE BOILER.

While the Navy Department is making experiments with water tube boilers for the purpose of finding out what is the most serviceable and desirable system of the type, and have not as yet been able to settle upon any one in particular, private enterprise is settling the matter commercially, and is building boilers which persons in need of such apparatus are very willing to wait their turn to get, and glad to get them when they do. This is the fact so far as the Roberts water tube boiler is concerned, for the manufacturers are to-day much behind their orders, despite the erection of new works last fall, and in the face of their terms, which are 25 per cent. of the price with the order and the balance when the boiler is ready for shipment at the works; this is practically payment in cash in advance, and the manufacturer states that in no case will there be any departure from this rule. We cite this not as bearing in any degree upon the boiler as a steam generator, but to show that purchasers are anxious to get them.

Since the Roberts boiler was first introduced to the trade it has been steadily improved in detail as experience demanded, and to-day it is practically perfect of its kind. This is the verdict of those who have it, and we need not go behind such evidence. From a mere experiment made by Mr. Roberts in 1878 in his own steam launch, the boiler has been developed into a powerful steam generator used in sea-going yachts of large size. One such is shown on this page, out of many others. The Roberts boiler is also used for stationary purposes, as shown by the engraving on the next page. The boiler proper is shown without its jacket in the next engraving.

Water tube boilers are in great demand, and our brief notice is merely to chronicle this one, which possesses great advantages as regards lightness for a given capacity, ease of access to all parts, great strength to enable it to carry high pressures, enormous grate surface, and the least possible vertical height. Combined with these are thorough circulation and durability.

We feel justified in speaking favorably of this generator from the fact that it has stood severe tests, out of which it has come unscathed. We have yet to hear of the first failure of a Roberts Water Tube Boiler. It is made by E E. Roberts, 107 Liberty Street, New York, who will send a fully illustrated pamphlet to any address.

◆

It was a common thing for Horace Greeley to indorse the note of almost any man who would ask him. The giver of the note would commonly fail to meet his obligation, and the debt would then fall on Greeley. The latter would swear dreadfully for a time and then pay it. It was a point of honor with him to discharge every obligation of this kind that he had assumed. In order to meet these and other debts he was compelled from time to time to sell shares of his *Tribune* stock. He originally held sixty shares of this stock, but his possession gradually dwindled to six. Whenever he was confronted with such an obligation he would say that he would have to sell another "nigger," the term he used to denote a share of *Tribune* stock.

◆

A hat having an umbrella-like sunshade, adapted to be conveniently expanded to afford shade, and to allow the free circulation of air about the head, while it may be easily collapsed to present the appearance of an ordinary hat, forms the subject of a patent issued to Mr. Stephen B. Bartine, Pleasant Plains, Richmond County, N. Y.—*Scientific American*.

Such a hat as this was publicly sold on the streets of this city over four year ago, so far as the sunshade is concerned.

Amusing idiocies continue to appear in the daily papers upon mechanical subjects. Here is one from the New York *Evening Telegram*:

> "Residents along the line of the Central New Jersey Railroad have been greatly interested of late in the trial trips of a new model locomotive. The engine has a self-balancing apparatus which throws the entire weight on the single driving wheel at starting, and on the pony trucks when under headway. It has also a compressed air device which rings the bell and ejects sand on the track at the proper time."

A locomotive with all its weight on a single driver, and subsequently on the pony truck, must be a useful machine. No one but a daily paper reporter could perpetrate such an atrocity as the above.

Here is another tremendous casualty from a press dispatch:

> "The engine was pushed to its fullest driving capacity. Coal was piled into the fire-box, and the engine, responding to the will of the engineer, flew over the track at a speed seldom attained by a freight train. Just before Odessa was reached, the rims of the driving wheels were partly melted off," etc., etc.

It would seem as though daily papers needed a mechanical editor badly.

Here is the typical press dispatch concerning steam engines:

> "The steel shaft is a solid cylindrical mass 20 feet long, 18 inches in diameter, and weighs $8\frac{1}{2}$ tons. A crankpin for holding a connecting-rod in place weighs 1,000 pounds. The flywheel is cast in four sections, in the form of four half wheels. The sections are joined so as to form two separate wheels, weighing 65,000 pounds, each being 18 feet in diameter. The two wheels, when placed side by side, produce one immense flywheel, carrying a belt 55 inches wide."

◆

It is believed that on many of the four-hour trials in British waters vessels are run for the four continuous hours, but that their speed is averaged only as a means of their runs over the measured mile made four times during the four hours' trial. In nearly every instance the result was in favor of the contractor.

BOILER MAKING. No. 34.

By John Cook.

Is it to be wondered at that there are so many boiler explosions where manufacturers and owners are so careless? The first in the construction of the boilers, and the other in hiring unskillful men to run the engines and boilers. Manufacturers should know that all parts of a boiler must possess equal strength; the dimensions of the various parts must not be calculated by applying a uniform factor of safety to the formulas expressing the strength of the respective shapes, but account must be taken of the continual waste going on in all parts of a boiler, in consequence of external and internal corrosion, and the wasting effect of the intense heat produced in the furnace.

Since the deterioration resulting from this cause affects different parts and forms in a different degree, the allowance of additional thickness of metal must vary accordingly. Care should be taken that such parts as cannot be got at easily to repair or replace should be proportioned with an extra margin of strength.

The plates of a boiler should be proportioned and stayed, not only with regard to strength, but sufficient stiffness must be given to them to prevent change of shape under pressure. A change of shape in one direction by pressure, and returning to its original position when the pressure is removed, will, sooner or later, result in a crack. The same is true when the braces are attached in such a way that the sheet is drawn from its true position.

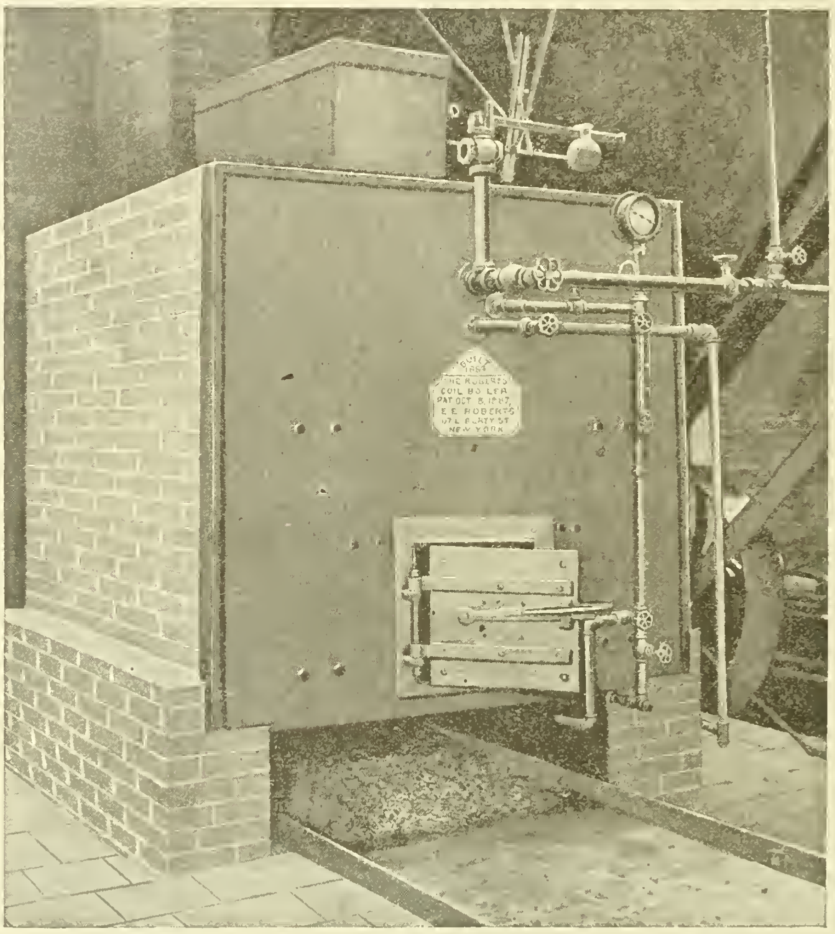
The tensile stress exerted by the maximum steam pressure on any part of a boiler should not exceed one-sixth of its ultimate strength. This factor of safety is usually employed for parts of machinery subjected to alternating stresses acting in opposite directions. The steam pressure in a boiler cannot be considered as a quiescent load, on account of the constantly occurring (sometimes considerable) fluctuations of pressure due to various causes; besides, the different parts of a boiler are subjected to continual expansions and contractions, owing to changes of temperature, the effect of which cannot be calculated, but is very marked under certain conditions.

The force exerted by expansion or contraction as the effect of change of temperature is equal to that which would be required to elongate or compress the material to the same extent by mechanical means. The linear expansion of ordinary wrought-iron plates is .0000064 of their length for each degree, Fahrenheit, of increase of temperature, and the same elongation is produced by a stress of about 150 lbs. per square inch of section of metal. It must be observed that this stress produced by increase of temperature is independent of the sectional area of the plate, and if the expansion or contraction of the plate is not allowed to go on freely, a corresponding stress will be exerted on the metal by a change of temperature. It must be remembered, also, that the strength of any structure should be measured by that of the weakest part, which, in the case of boilers, are the joints where the sheets are connected, also the bracings. All longitudinal joints should be double riveted. The distances and size of rivets I have given before, but in regard to bracing, I must say a few words more, as there is so much carelessness and ignorance, or both, displayed in the bracing of boilers.

In calculating the strength of braces it is generally assumed when the plates are thin, relatively (as in stationary boiler-heads that are put out by most shops) to the pressure of steam carried in the boiler, that each brace has to bear the whole strain due to the pressure on the portion of the surface it supports, and they should be spaced evenly in parallel and perpendicular rows, and a large factor of safety, ranging from eight to sixteen, used in calculating the strength of them, on account of the constant diminution of their sectional area by corrosion, uncertainty of welds, etc. Welding should be avoided as much as possible in boiler braces, for the strength of the brace depends on the soundness of the weld; frequently the iron at the weld is more readily attacked by corrosion than at the parts where the fiber has not been disturbed. Where welding has to be done on braces it should be by a good blacksmith, not, as is usually the case, by anyone that can stick a couple of pieces of iron together.

On oblique stays Haswell says: "Stress upon an oblique stay is equal to stress which a perpendicular stay supporting a like surface would sustain divided by the cosine of angle which it forms with perpendicular to surface to be supported." Illustration: assumes pressure to be 110 lbs. per square inch, of supported surface 36 square inches, and angle of stay 45 degrees, what would be the pressure, or stress, upon stay? Cosine of $45° = .70711$; then $110 \times 36 \div .70711 = 5{,}600$ lbs., which I think would be sufficient for a brace made of $1\frac{1}{8}$ round iron to stand. Now I think Haswell means stays of 1″ area, and $1\frac{1}{8}''$ round iron is the nearest we can get to it. How, then, can it be supposed that braces with but one-half the area will support a three times greater surface? for very often we see braces spaced from 10 to 12 inches apart, and without regard to where they were placed; just dropped down anywhere on the head. I am sure that it would surprise many of your engineer readers, if, when they go inside of their boilers, they would take a rule with them and measure the distance from center to center of crowfoot and calculate the surface supported by the brace. They will find more braces made of $\frac{3}{4}$ round iron than of 1″ and $\frac{3}{4}$ iron has not one-half square inch area. I cannot understand why the part of the head in a stationary boiler unsupported by tubes should not be as well braced as the sides or crown sheets of a locomotive boiler.

(*To be continued.*)



THE ROBERTS WATER TUBE BOILER FOR STATIONARY USES.

WAGES.

In close connection with the subject of skilled industry is the wages problem, and, unless there is a better understanding of this subject among workmen, there is danger of both work and wages coming to an end, temporarily, at least. The whole theory of wages among workmen is a delusion, but one they are not wholly responsible for. For years past they have been taught that wages depended on "demand and supply." A most pernicious doctrine! If this were true, why not cut off the supply and raise the price? They have been told in a hundred ways that wages can be high in one place and low in another; that the wages in one country have nothing to do with wages in another, when the things produced have to go into the same market. We are speaking of the *amount* of wages, not the *rate*. The "rate" of wages, the world over, depends on what men produce, and, so long as this is true, it does not matter how high the rate may be. An American watchmaker may earn four dollars a day, and a Geneva workman forty cents a day. That makes no difference, so long as the "amount" of wages in the watches is the same, but as soon as the "amount" of wages is increased in any country, or in any part of a country, the industry thus affected must cease and perish. In many of the skilled trades in San Francisco the "amount" of wages has been raised above the Eastern States and above other countries, and the result is seen. If this amount is raised even ten per cent. there is not an industry on this coast, depending on an open market, that will last two years. It is nonsense to assume anything else.—*Industry, San Francisco.*

◆

No less than four engineers have resigned from the Navy within the last month. It is not difficult to see what is the matter. The pay is too small, the accommodations or quarters aboard ship are insufficient, uncomfortable, and not such as men of their rank are entitled to and should have. This thing of penning up grown men in the steerage in cuddy holes hardly big enough for small boys is absurd and shameful. The engineers should have as good quarters as officers of corresponding rank; and, by the way, it would improve things to give them the actual rank and right of title used by line officers. The comfort, welfare and rights of the engineer officers must receive more consideration, or we shall have the best of them leaving the service and accepting civil positions with better pay and more perquisites.—*Marine Journal.*

◆

Among the boiler explosions reported is one at Alliance, Ohio. The closing words of the account are delicious. "The explosion," it says, "resulted from mineral in the water corroding the boiler, which was nearly new, and doing the work of two, the other having exploded a week ago." A lively time they have been having out there, yet how calmly and unconcernedly the reporter speaks of it! Ordinarily we should expect to hear that "the air was filled with sections of shell, fragments of broken heads and braces, and vast clouds of rivets and tubes": but in this case the populace seems to have been surfeited with such things, and an explosion or two, more or less, makes but little difference—except to the unfortunate engineer and his family.—*The Locomotive.*

◆

A good deal of the trouble of this life is due to the fact that people will persist in working hard to get things that they do not need and never ought to want.

WEIGHT OF MACHINERY.

For several years the tendency has been to cut down the weight of the machinery in ships of war far below what is absolutely necessary for strength and safety. As a result a point has been reached at which even the most progressive (?) are disposed to cry halt! and are beginning to realize that ships which only succeed after repeated trials, in obtaining the contract power, and which never afterwards attain it, are useless for the purpose for which they were designed. We have been following this example, and in cutting down the weight of machinery have reached, if we have not passed in some of our ships, a point beyond which it is not safe to go. Our machinery can be designed and built just as light as anybody else's, and it will probably run just as well and just as long as theirs, but sooner or later the machinery will fail, and when such failures occur it is usually in an emergency when all the power that it was intended to develop is needed. It would indeed be a sad reflection on us if one of our new ships should fail when most needed. I therefore recommend that a limit be fixed to this continued fining down of weights, and that the endeavor be to produce machinery that may be relied on for service at sea and produce a reasonable power for a given weight, instead of striving, as at present, for an engine that will on the measured mile develop more horsepower for weight than ever produced before, and then, as likely or not, be laid up for repairs.

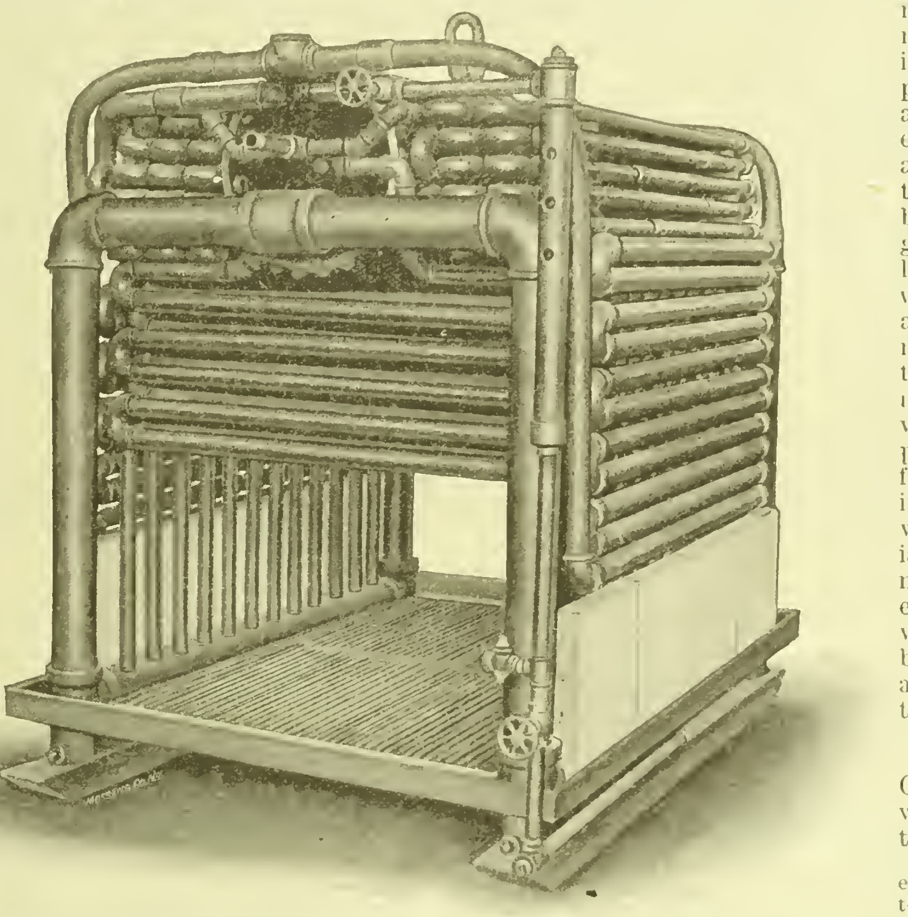
The use of steel for machinery castings has not been attended with the success anticipated; and for several of our new vessels, the attempt to get good castings, even after repeated modifications of the pattern, has only been successful when the thickness of metal has been increased to what would be necessary for cast-iron. In many cases, even in comparatively simple castings, the contractors in order to avoid delay, after several failures, applied to substitute cast-iron or other metal for cast steel. Unless reliable steel-castings can be obtained which are as much lighter than cast-iron ones as would be warranted by the greater strength of steel, it is simply a waste of money to use them; and in designing machinery based on the strength of cast-steel, we are getting the light weight only on paper, if it becomes necessary in casting to increase the thickness to what would be necessary for the same parts if made of cast-iron. In such cases we are only increasing the cost without getting any benefit from the change of material.—*Report Chief of Bureau Steam Engineering, U. S. N.*

◆

Two San Francisco rascals have recently been working this trick: Purchasing a load of cheap, sulphurous steam coal, they start out in the residence portion of the city, and come to stop in a rut of a populous street. After shouting and apparent effort to go ahead, they abandon the attempt, and go from door to door, saying to the housewives: "We have broken down with a big load of Wellington coal. As we cannot get away with it, we'll sell it to you for $8.50 per ton. It's a bargain." A woman is soon found who will take the bait, and the condition of her house thereafter is more sulphurous and stifling than a snowshed.

◆

If you wish to be liked you must be likeable.

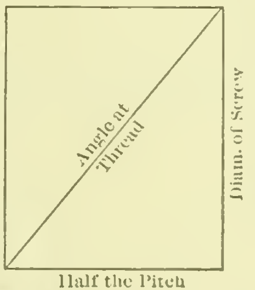


THE ROBERTS WATER TUBE BOILER WITHOUT JACKET.

Concerning the capacity of fire-brick furnaces for retaining heat the *Railroad and Engineering Magazine* says: "But let us see how much heat a fire-brick fire-box will hold. If the fire-brick is 5 in. thick, the lining of an ordinary box 6 ft. 6 in. long would weigh about 6,700 lbs. It will also be supposed that at the end of the run this is heated to a temperature of 1,000°, and that the steam pressure is 150 lbs. Now the temperature of the water under a steam pressure of 150 lbs. is 366°. When the fire-brick is cooled down to that temperature, no more heat will be transmitted to the water. Consequently, it is only the difference between these temperatures, or 634° of heat, which can be transmitted to the water. The specific heat of brick is only one-fifth that of water, so that the amount of heat in the fire-brick which can be utilized in making steam would be ascertained by the following calculation, $\frac{6,700}{5} \times 634 = 849,560$, or, say, 850,000 units of heat. It takes 858.9 units of heat to convert a pound of water into steam of 150 lbs. pressure if the water is heated to the temperature of the steam. Therefore the heat in the fire-box would convert a little less than 1,000 lbs. of water into steam if all the available heat was transmitted to the water. This would be equivalent in effect to the combustion of about 140 lbs. of coal, on the improbable assumption that all the heat above 366° is transmitted to the water in the boiler."

◆

A method of finding the angle or rake of a screw-cutting tool for cutting square threads is this: Draw two parallel lines the same distance apart as the diameter of the screw to be cut. Draw two more parallel lines at right angles to these lines, and of a distance equal to half the pitch of the thread to be cut. Then draw a diagonal line as shown in the sketch which will represent the angle of the thread. — *Mechanical World.*



◆

Doubtless numbers of our readers wondered what we meant by "gouged" twist drills in the last issue. We did not mean anything; the copy said "forged" but probably no one could make it out.

ERICSSON'S RAT-TRAP.

Prof. McCord, who was for many years Capt. Ericsson's draughtsman, relates this incident in the *Scientific American:*

"The captain had found his tenancy disputed by a horde of rats, who stubbornly refused to yield possession. Regarding the situation as a problem to be solved by mechanical means, with his own hands he drew the plans for a mighty trap. To the leading idea (a water tank beneath a trap door) he laid no claim, but the details were wholly new and upon an unheard-of scale. Tracings were made by an assistant draughtsman, and went the rounds of the shop; the pattern maker, the brass founder, the finisher, the carpenter, the tinsmith, each had a share in this novel work. At last it was completed and erected; it filled up half the basement, and was baited with half a cheese. He had originally intended to use a whole one, but though cost had been disregarded in making the trap, he suddenly became gravely economical in the matter of bait, and at last decided that a moiety would suffice; the other being placed in an adjoining room to guide the noble army of martyrs in the road to ruin. But he had underestimated the cunning of the rodents; as a place for keeping cheese in safety, the ponderous engine answered admirably, but it did not even frighten the obnoxious animals; and he was forced to admit that 'these little beasts have brains altogether too big for their heads.' Before this time, when some over-ambitious and unsuccessful piece of mechanism came to his notice, he used to say, like many another, 'The man who contrived that couldn't plan a rat-trap.' And the force of habit sometimes impelled him even afterward to use the same familiar ejaculation: but the memory of this failure was ever present with him, and with a merry twinkle in his blue eyes he invariably added, 'And I couldn't do that, either.'"

◆

The *Woodland Mail* of California says this is the way George Wiseman of that place tests a boiler:

"There was no one near the engine, so I thought I'd give it a test. I screwed down the throttle-valve, and the gauge piston registered 125 pounds. Now, I never use more than 100 pounds of steam, so I have much confidence in the boiler. It is true that the shell has been burned by the heater, but an explosion could not occur so long as plenty of water was in the boiler. The heater on the engine was taken off many months ago, so the engine will get no worse than it is now. Mr. Wiseman further said that he was not an advocate of heaters. The heater kept the water at a temperature verging on boiling, and this had a tendency to cause rust. While steam may be generated quicker by a heater, he does not think it as strong as steam generated from cold water. 'In case the engine should give way,' he said, 'I think it would be at the bottom of the boiler. Those standing near would undoubtedly be scalded, but as the boiler does not contain a great deal of water, the boiling baptism would not last long. In case of an explosion there would be very little of the machine left. It might fly all over the neighborhood, but so long as I keep plenty of water in the boiler I do not anticipate an explosion.' Mr. Wiseman understands boilers and engines perfectly, and for this reason his judgment of the engine will be read with interest."

Fine, isn't it?

◆

The Quintard Iron Works, of this city, have recently put in a Belleville tubulous boiler to run their steam hammer. It was thought at first that the boiler could not supply steam in sufficient quantity, but so far no trouble has been experienced. It is understood that the Quintard people are highly satisfied with the boiler.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

THE SURPRISING ADVENTURE OF A LADY CHIEF ENGINEER.

Editors ENGINEER:

Being a constant reader of your ENGINEER, I notice your invitation in January's issue for readers to give their views on "*Subjects you have had experience with.*" I venture to express mine. Subject: A leaking check-valve. Time and place, August, 1888, Bath, Me. The occurrence, or, I may say, adventure, was on my husband's steam launch. Size of boat, 30×4½×14. Upright boiler, the engine 3″×5″ condensing. My husband (a Boston physician), myself and son, had been doing the Kennebec river and vicinity in our boat, making our headquarters at Bath. During our many runs "up and down and round about," I had become somewhat proficient as an amateur pilot, engineer, and captain; and I am told that as an engineer I bid fair to become quite a practical if not a theoretical expert; but as a captain I was a dead failure, for my crew always mutinied and threatened to jump overboard when I took command. Knowing this, I felt it my duty to become familiar with engineering, that if my crew wholly deserted me I would be able to do without them, and get my ship safely into port. With this object in view I began to study engineering. I soon learned how to keep up a good fire and not burn out grates, how to give steam, how to reverse and to link up, what parts to oil; I learned the principles of air pump, condenser, vacuum, hot well, and its proper temperature, feed-pump, inspirator and heater, the course of the water to the boiler, and its conversion into steam. Ah! steam! I have been studying that ever since. I learned the economy of cut-off and expansions; I also gave thought to the different styles of engines. In the Bath Iron Works I had good opportunity to look into the intricacies of compound and triple compound engines.

Various styles of propeller wheels also claimed my attention. The action of water in the boiler, the proper pressures, the safety valve, the jet, the blow-off, the water glass, the gauge cocks and steam gauge, the indicator and its pretty diagrams, also claimed my attention. I made close acquaintance with all these. Indeed, I thought I did, but I find as time advances that my "close acquaintance" was not an acquaintance at all, not even speaking terms! I am still studying how to know them better, and had I the space at command could furnish a good list of reading matter on how to become a virtuoso engineer, if not a "first rater." But to return: "It was August the third and quite soft were the skies," and like Ah Sin, I was "likewise," for I ventured to "go it alone" on a trip fourteen miles up river. It was my first venture as "engineer-in-chief" all by myself. In company with my fourteen year old son I boarded the steamer, started my fire, and awaited results. Soon the steam gauge indicated 60 lbs. and I concluded to cast off for a run to the coal wharf half a mile below, and filled the bunkers with coal, but, as I happened to glance ashore, I noticed a sailing party composed of some dozen or more males and females, who, while awaiting the arrival of their yacht, were amusing themselves by watching me. My pride was now at stake. I must make a good showing, especially as this was my first venture, and one or two of the ladies on the wharf, I knew, were aware of this.

I pretended not to notice them, put on more coal—turned on the jet, gave the engine an extra dose of oil, looked to my water supply, gave the engine a few turns, and when the safety-valve began to sizzle (noticed that steam was up to 130 lbs.) shut off jet, cast off, opened throttle, and away I went at the rate of a mile in five minutes, giving three toots in response to the applause and handkerchief waving which greeted my departure. So far all was a success; my engine was turning 430 revolutions per minute. My son, who was pilot, was letting his tongue run much faster. He had evidently taken command and was in an excited state. Repeated directions from his lips authorized me to do this and that, such as "Shut off steam; we are going too fast." "Why don't you go slower, don't you see that towboat is heading for the same wharf we are going to?" "What is the matter with that safety-valve?" "What are you thinking of; don't you see that the ferryboat is coming up?" "Blow your whistle!" then, "*Why don't you blow that whistle?*" and so on.

All this I paid little attention to. I was the engineer and, proposed to be captain also, and by no means to be directed by a boy. I felt the responsibility of all this, also the converging tow and ferry-boats. I kept cool, however; opened my furnace door, and so stopped the safety valve from lifting, directed my son to steer across the bow of the towboat and thus allow them to land before I did, and also to give me a larger circle to come about in at the coal wharf. I blew whistle accordingly and the tug responded. At the same time the ferryboat blew twice in response to the tug, not knowing that she had blown for me, instead of her customary once on leaving the slip; this I had nothing to do with, nor indeed had the tug, as neither of us was to cross her course.

My son by this time had lost his head entirely. I am sorry to say that he followed his father's example when he gets angry—he swore. Oath after oath was wafted to my horrified ear; horrified that my son could swear. He declared that I was incompetent, that we would be run into, that he would never come out with me alone again; that his father should know full particulars, and then I could never venture out alone again a second time. "Why don't you stop her?" "Why don't you go faster?" "Look out!" "Look out!" Meanwhile the bows of the three boats pointed to one center. My plan was to allow the tug to cross my bow and then I could keep my course without shutting off steam, and arrive at the wharf in proper order. The ferry-boat stopped altogether, thus allowing the towboat a free course ahead. This not being his course he also stopped, probably because he saw me in command, and distrusted my ability to handle my boat properly; his course would have been to run direct for his wharf. As both boats had now shut off steam I was forced to change course, blew two blasts of the whistle to the tug, and shot in at full speed across his bows to my destination, at the same time blowing a salute. I got a response from both. My poor son was now nearly dead from excitement and fear; he demanded to be put ashore immediately, but after we were tied up at the wharf he soon regained composure and started to order the coal. Now then occurred one of those events which all engineers are liable to experience. If they are not better prepared for it than I was they have my deepest sympathy.

A breakdown at sea must be a terrible strain on the engineer; for me, even while tied up at the wharf, it seemed equally bad. As I shut off steam I noticed a rumbling and a cracking which I could not account for. Not stopping to attend to my fire, I gave my whole attention to finding the cause of so peculiar and so strange an occurrence. Glancing at the water gauge I noticed that the water was rapidly falling; at the same time the safety valve lifted. I thought it would never stop blowing. In a minute the water in the glass had disappeared from view, and the crackling, rumbling sound was growing louder and more frequent. I also noticed a rumbling in the tank and now and then a quiver in the boat.

During the moment all this happened I thought fast and much. I expected to be blown up or to die of fright, but I kept studying, and on a partial conclusion started to work. Now, when I began working all fear or thought of accident left me. My whole attention was given to stop the flow of water from the boiler; first I closed the stop valve. Like all small globe valves it leaked, and I re-opened it and then started engine and pump.

No go! The feed pipe, now hot with steam, cracked louder and louder, the safety valve closed. I then seized a monkey wrench and pounded on the check valve, which was placed some eight inches behind the globe stop valve; 'twas useless. The inspirator next claimed my attention. It would not "catch." I thought it must be too hot, so attempted to cool it. It was a waste of time. I now realized that something must be done to save the boiler, for there could not be much water left, so I hastily covered my fire with wet ashes, at the same time opening throttle and safety valve to full extent. When I started to cover the fire I noticed my steam gauge registered 120 lbs.

In a larger boiler I should have hesitated about liberating steam in this manner, but with this one I felt safe, for I had seen it tested to 255 lbs. hydrostatic pressure, and feared little a flash of steam. As the pressure went down all noise ceased. The check valve had seated itself. I was safe, but by no means out of the scrape. I now tried the inspirator; joy to my weary nerves, it "caught," and I soon saw water again at its proper level. Now all this had taken up some three to five minutes, and I soon heard my son loading in the coal. Looking out on to the wharf I noticed three teams backing up to load with coal, and the genial countenance of Captain H., the coal agent, smiling upon me. The coal being in, I started up my fire to get ready for the trip up the river. I was about to cast off, when, horror upon horror, the check began to leak, the steam to open up safety valve and to frighten the teams on the wharf. What should I do? The inspirator failed again, the cracking grew louder, and the men on the wharf had all they could do to attend to their frightened horses.

Captain H. cried out at the top of his voice, "Can't you move ahead! your steam is frightening the horses."

"No," I replied, "not just at present; I dare not start." The horses were now dancing and prancing about, the drivers cursing them, and my son, oh, my son, he was swearing louder and more eloquently than all of them put together. One driver, an Irishman, came to the boat side and yelled out:

"Madam, won't you stop that steam or get out of this?"

"No," I replied, "I don't leave until the tide turns?" He turned to his companion and I heard him say, "My God, Bill, hear that! What shall we do?"

Well, what was to be done? I now had an extra complication to contend with—my son. He was aft giving me orders and directions, and declaring that we would be blown up. When I told him I thought we would be, he deserted me and the vessel for assistance on shore to help him get me off the boat. He thought I was crazy.

There were some fifty or more idlers at this time on the wharf who had become interested in the proceedings. When my son called for assistance, saying that the boiler of the launch would soon blow up, the crowd took flight and made one grand rush up the wharf, with the frightened teams after them, upsetting wheelbarrow loads of coal, and spreading consternation in every direction. This stirred up more excitement, and soon an engineer from somewhere came to my assistance, followed the course I had previously followed, and left me fireless, steamless, exhausted, but still aboard ship. I was so mad I was bound to conquer or be blown up To conclude the story, my son took the tender and towed me back to our mooring after the most exciting hour of my life. I still have that worn check-valve, which was removed the following day.

The incident taught me more than any volume. I firmly believe the old saying is true which states that the hair stands on end when a person is frightened; my scalp was sore for days. I also thought my hair would turn white, and watched daily for it to do so. During the five minutes I lived a lifetime. I pictured myself blown into fragments and my husband so far away receiving the news. When I left the boat I felt sixty years of age instead of thirty-one. I would not have accepted as a gift the finest yacht afloat. I felt my engineering days were ended. But, Mr. Editor, the fever still rages. If you consider my experience any value to your readers, I should be pleased to read your comments on it or to see it in print. 'BUTTERCUP.'

[We have no comments to add. Anything would be tame after this. We had a small experience with a steam launch a few years ago, which may be told in a few words, but, we fear, not so spiritedly as our correspondent. With half a dozen ladies on board (young, of course), and a deckhand, we started on a trip up the river. Half an hour out, one of the ladies gave a screech and declared she was scalded. Looking in her direction we saw a stream of water about a quarter of an inch in diameter squirting from some point around the bottom of the boiler. Looking further we saw that it came from the feed-pipe where it entered the boiler. The pipe fitter had made a short nipple which he had carelessly just entered in the boiler and forgotten to screw home. It hung by two threads. In fact we could see the end of it. Luckily there was an elbow outside the check-valve where the pipe made a turn, and calling the deckhand we made him put his foot against the elbow and brace for all he was worth, while we ran the boat up to the bank. That was the worst quarter of an hour we ever spent, but through good fortune we upset no wheelbarrows and frightened no one but ourselves. We did swear some at the pipe fitter, which we think we were justified in doing.

We hope for our own and our readers' sakes that *Buttercup* will relate further experiences. She did the right things at the right time.—EDS.]

CAPTAINS AND ENGINEERS.

Editors ENGINEER:

I have just finished reading the article headed "*Breaking the Record*" in the last number of THE ENGINEER. Also the article entitled "*Credit to Whom Credit is Due*" embracing a set of resolutions presented to Captain Henry Parsell, R. N. R., of the '*Celtic*' by the passengers on that ship. It seems to me that a captain who accepts such a compliment, and takes all the credit to himself when he is fully aware that he is entitled to only a very small part of it, and knowing that he is appropriating that which belongs equally to his fellow officers, is as culpable as the passengers who signed the resolutions. If I could get possession of their names I would send them each a copy of THE ENGINEER of Feb. 15, with that article heavily underlined. Catering to the vanity of a swelled head captain! Any captain who would accept such a set of resolutions must have not only a bump of vanity but a bump of dishonesty as well, most abnormally developed. When, oh when, will engineers get justice? I wonder if the thought ever suggests itself to the people who present captains with gold watches and sets of resolutions how fast the ship would sail if the engineer should find it necessary to stop the engines just when the captain is impressing them with his extraordinary skill and ability to forsee and provide for such emergencies!

No engineer has ever claimed that the captain had no part in fast passages, but where is the captain who has the honesty to give the engineer credit for the wonderful achievement of fast passages.

Let justice be done, and may THE ENGINEER continue to champion the cause of its illustrious namesakes is the wish of A. KRANCKE.

New York.

[This is a matter in which we are all interested, and, considering the relative risks and responsibilities involved, the engineers are fully entitled to recognition. It is all plain sailing for the deck department very often, and with a clear road and a fair wind the captain and chief officers have a picnic, but there is no plain sailing down below, and there are never any picnics; that is to say, none of a festive nature. There are some when the high pressure pin gets red hot, but no one has any fun with it. This wholesale laudation of the captain as the only man on the ship is a tradition of the sea, and belongs to the day of sail vessels, when it took seamanship to bring a ship out of trouble. But now, when captains have thousands of horse-power beneath them, he must be a lubber indeed who cannot bring a ship safe home. Mr. Krancke has our thanks for his timely protest.—EDS.]

A LATE PROTEST.

Editors Engineer:

I have been a subscriber for The Engineer for about four years, and think it the best paper published of its kind. For the last two years some one has made a great mistake in misspelling the name of the street. Last year you had it "*Bellvile,*" now you have it "*Belloine.*" Please address future papers to Bellevue Avenue. The letter-carriers are finding great fault on account of the above.

Detroit. A. W.

[This letter is published for the benefit of all, as it accounts for some complaints of non-receipt of the paper. It is not possible for us to know the proper spelling of all streets, and—as noted by our correspondent—the authorities kick.

We respectfully request all to note the above, and also not to wait a year or two before notifying us.

◆

TURNING CAST-IRON.

Editors Engineer:

I noticed an item in your last issue on finishing cast-iron with a spring-tool. I think that a spring-tool is away ahead of a scraper for finishing heavy work that cannot be filed, such as cylinder heads, etc. I have used a sharp spring-tool and water on this class of work for years with satisfactory results. I know there are plenty of men that will laugh at the idea of using water on cast-iron, but if they will try it on the next heavy job they get, using a keen spring-tool, I think they will be well pleased with the result. F.

New York.

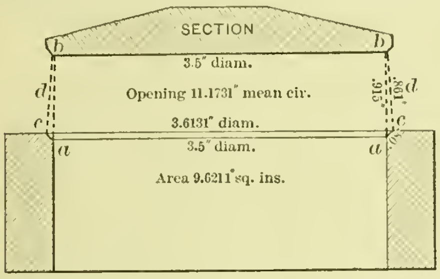
◆

LIFT OF SAFETY VALVES.

By Charles Sperry.

R. E. B., Pa., asks: "What amount of lift must be given a safety valve $3\frac{1}{2}$ ins. diam., having a seat with an angle of 45° to the center line of its axis and a depth of .08″, to produce an area of opening equal to that of the valve?"

It may be difficult to arrange a solution of this question so that those who have no knowledge of plane trigonometry, or solving triangles, will perfectly understand the principles of the calculations, but I will try to make it as plain as possible and find the answer by simple methods and figures, so that all can perform similar problems when desired, which is one of the best qualities of The Engineer, for what cannot be explained with familiar words and be computed by common arithmetical operations is not of much use to every day practical men. The full size outlined section of a valve and seat is sufficient for our purpose. Decimals below four figures are dropped from the results.



The diameter of the valve seat opening, or distance *a a*, is 3.5 inches and we first find its cross-sectional area by multiplying the square of the diameter by .7854, thus: $3.5 \times 3.5 \times .7854 = 9.6211$ square inches. Then the question is, how far must the valve rise to allow a clear opening around its circumference, between the valve and seat, of 9.6211 square inches area? It is evident that the area of this opening is the product of the distance between the lower corner *b b* of the valve and (with the given angle of valve seat and a high lift) the upper corner *c c* of its seat multiplied by the mean circumference of the opening. As it is necessary to know the radius or diameter of the corner *b b* of the valve, we will assume it to be the same as that of the inner corner *a a* of the valve seat, namely, 3.5 inches diameter. The diameter of the upper corner of the valve seat, or distance *c c*, must also be ascertained. This we can do by adding twice the sine of the angle (found in tables) of the valve seat, multiplied by the width of the seat *a c*, to the diameter of the valve seat opening *a a*. Looking in a table of natural sines, we find that the sine of 45°, the angle of the seat, is .7071, hence: $2 \times .7071 \times .08 + 3.5 = 3.6131$ inches diameter *c c*. Now it is plain that by adding together the circumference of the valve at *b b* and the circumference of its seat at *c c* and dividing their sum by 2, will give us the mean circumference of the opening between the valve and seat at *d d*, and for any height of the valve above a point at right angles to the face and corner *c c* of the seat. What amounts to the same thing with less figures, is to add the radii together, or take one-half of the two diameters, and multiply by 3.1416; therefore, $\frac{3.5 + 3.6131}{2} \times 3.1416 = 11.1731$ inches mean circumference of the opening between valve and seat. If now we divide the area required for the opening by the mean circumference, the quotient will, of course, be the width of the opening or distance *c b*, which, $\frac{9.6211}{11.1731} = .861$ of an inch. This distance from *c* to *b*, obviously is not the lift of the valve, and we must now proceed to find out what the lift is by a few rules of trigonometry (but don't let the big word scare you). It can be seen, by the broken lines at either side of the diagram, that we have two sides *a c* and *b c* of a triangle and the angle *a* opposite one of them, and it is required to find the other side *a b*, the length of which is the lift of the valve. The side *a c* is the width of the valve seat, .08 of an inch; the other known side, *b c*, we have found to be .861 of an inch, and the angle, *a*, opposite this side is 45 degrees. First we will find the other angles, *b* and *c*, by the rule that the sines of the angles are in the same proportion to each other that the sides opposite these angles are to each other. For angle *b*, stated in simple proportion, *b c* : *a c* :: sine *a* : sine *b*. The rule is to multiply the side *a c* by the sine of angle *a*, and divide the product by the side *b c*; the quotient will be the sine of angle *b*. Using the given figures, and the sine of angle *a*, 45°, being .7071, we have, $.08 \times .7071 = .056568$, and $.056568 \div .861 = .0657$ = sine of angle *b*. In our table of sines we find that the angle having this sine is 3 degrees, 46 minutes, which, therefore, is the angle *b*. As there are 180 degrees in a triangle, we obtain the angle *c* by subtracting the sum of the other two angles, *a* and *b*, from 180°, thus: $45° + 3° 46′ = 48° 46′$, and $180° - 48° 46′ = 131° 14′$ = the angle *c*. The sine of angle *c* is found by subtracting its number of degrees from 180°, and taking the sine of the remainder or supplement of the angle, when $180° - 131° 14′ = 48° 46′$, the sine of which we find to be .752 is also the sine of angle *c*. Now we can find the length of side *a b* by multiplying either of the other sides, *a c* or *b c*, by the sine of angle *c*, and dividing the product by the sine of the angle opposite the side taken, as $a\ b = \frac{a\ c \times \text{sine}\ c}{\text{sine}\ b} = \frac{.08 \times .752}{.0657} = .915''$ or $a\ b = \frac{b\ c \times \text{sine}\ c}{\text{sine}\ a} = \frac{.861 \times .752}{.7071} = .915$ of an inch, which is the lift of the valve when the opening between it and its seat is equal in area to that through the valve seat.

◆

An inventor has been to the trouble of reviving the old register valve—a disk with radial openings—for use as a steam valve. More than 35 years ago we "invented" this ourselves, and various other persons have invented it as the spirit moved them. Such a valve is of no utility, for the reason that the velocity of the surfaces in contact is so unequal that the wear is unequal, and it will never be tight in use.

◆

Respecting premonitions, this is curious. Henry J. Raymond, well-known to New Yorkers as editor of the *Daily Times*, some years ago always dreaded that some evil would befall him in his fiftieth year. He could never explain the fear, but he had a premonition that he would never see the end of his fiftieth year. He died at the age of forty-nine years and five months.

◆

A Supreme Court in California, has decided that owners of buildings are common carriers of passengers in their elevators, and are responsible for any accidents to persons.

FACTS AS EVIDENCE.

We are always anxious to receive facts in relation to matters connected with steam engineering. Mind, we say facts. There is an immense difference between facts and theories. Taking one fact and reasoning from it that a hundred other things must be true, leads to serious error. The number of steam engine tests that have been made would reach way up into the thousands, but how few of them are of practical value! It is a job well nigh impossible to bring all the conditions of a test of steam engines down to a fair level. Justice to one may be rank injustice to another. The truth is that we are simply trying to learn something about the steam engine, but in the majority of tests made it is taken for granted that we already know a great many things about it which we know nothing worth speaking of.

How slow a process it is to get at the truth is very clearly shown in the controversy about the economy of compounding locomotives. Not only do different men arrive at contrary results in relation to this subject, but one man feels obliged to revise his opinions at frequent intervals. After all, the proper test of a steam engine used for any purpose whatever, is the practical test of every-day work. What is wanted is a knowledge of what it costs by the year to operate an engine, not how little water will be used in a snap test of a few hours.

A good many things enter into the cost of operating an engine. And those things that are outside the question of coal consumption, or the water used, may over-balance a small saving in these respects. But a short test—the usual test—takes no account of these things.

What may be called the staying quality of an engine may be a very important factor, as, for example, when a shut-down will cause serious loss and inconvenience. The mere dollars and cents cost of repairs may not amount to a great deal, but the incidental delays may amount to a serious loss.

Of course if an engine is seriously wasteful of steam, a short test will make this fact manifest. But when it comes down to the fine percentages of the expert, such tests are clearly unreliable.

What is wanted is not a test of the expertness of the expert, but a test of the valuable qualities, as a whole, of the engine; such a test must come through the experience of time.

◆

Nature has guarded against injury to the pneumogastric nerve with extraordinary care. On either side of the windpipe, where it lies exposed in the neck, is a tough, fibrous sheath. Within this sheath, occupying the part nearest the front of the body are the carotid artery and jugular vein side by side. Behind them is the great pneumogastric nerve. The sheath and its contents are well buried under the external muscles of the neck. The function of the pneumogastric nerve is to steady the heart's action. It is like the governor of a steam engine. The impulses all travel from the brain to the heart through this nerve, and never the reverse way. Whenever the heart begins to beat too fast the pneumogastric nerve transmits the orders from the brain to "slow up." and the heart at once obeys. Now, it has been found by experiments on animals that if this nerve be stimulated by an electric shock it will carry such a sudden and violent impulse to the heart as to cause that organ to stop beating altogether for the moment. It has also been found that a sudden blow, or anything that causes the nerve to be suddenly stretched, will have the same effect as an electric shock.

◆

Riveting by electricity has been successfully accomplished. The cold rivet is placed in the hole, and when heated to the proper temperature it can be closed by any of the ordinary apparatus now in use. The heating of a half-inch rivet of two or three inches in length takes about half a minute.

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EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, MARCH 1, 1890. No. 5.

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EGBERT P. WATSON, JR.

ON the 25th of February, Egbert P. Watson, Jr., beloved son of Egbert P. Watson and Louisa E. Watson. The cause of death was Bright's disease. Friends will find further details in the next issue.

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BOILER DESIGNING. NO. 1.

By DE VOLSON WOOD, Professor Engineering, Stevens Institute.

THE engineer seeks to reduce, so far as possible, the solution of all problems to definite rules; but, in many cases, experiment and experience only furnish certain limitations.

A marked example of this character is furnished in the designing of a steam boiler. Theory furnishes more definite rules for determining the thickness of the plates and dimensions of the rivets than it does the proper size of the heating surfaces and the water and steam spaces. There are the parts pertaining to the strength with which theory treats only imperfectly—such as the strength of flat plates subjected to an assumed normal pressure, stay bolts and stayed surfaces.

Suppose it be required to design a boiler that will supply steam for a 100 horse-power engine. The first thing to be determined will be the quantity of steam required—that is, the number of pounds of steam required per horse-power per hour. To determine this theoretically the steam pressure to be used must be known, the cut-off, the clearance, the back pressure, and the probable per cent. of steam condensed in the cylinder. It is found from the principles of thermodynamics that if a pound of steam worked in a cylinder, beginning with 100 pounds pressure per square inch, ratio of expansion *ten*, there being no clearance nor condensation, and a back pressure of seventeen pounds per inch, that a pound of steam would do about 123,000 foot pounds of work, and allowing for all the wastes above named we may assume that it will do about half this amount, or 61,500 foot pounds. If this pound worked for an hour, then for each minute it will do $\frac{1}{60}$th of this amount, or 1025 foot pounds. A horse-power is equivalent to 33,000 foot pounds of work per minute, hence it will require $33{,}000 \div 1{,}025 = 32$ pounds of steam per horse-power per hour. This analysis indicates how a designer may proceed arithmetically, but in practice it is not necessary to go through with this computation, for it is known by actual experiments that in the best condensing engines a horse-power is developed by 16 pounds of steam used in the cylinder per indicated horse-power per hour (and a few cases are cited where a less amount has been required), and good non-condensing engines require from 30 to 45 pounds of steam per indicated horse-power per hour.

Assuming, then, that 32 pounds per horse-power are required, it will be necessary, in this example, to generate 3,200 pounds per hour—a considerable amount, being about $1\frac{1}{2}$ tons of water per hour. This would enable us to determine the steam and water capacities of the boiler, if it were known what space should be allowed per cubic foot of water evaporated. There is no theoretical way of determining this. Mr. Robert Armstrong, an English authority of some years ago, allowed 27 cubic feet of boiler capacity per cubic foot of water evaporated. This is equivalent to multiplying the pounds of water evaporated by 0.43, nearly; but as the rule is arbitrary we will use 0.4. This would give, in our example, $3{,}200 \times 0.4 = 1{,}280$ cubic feet, so that when the length of the boiler is given the diameter may be found. If the length be 10 feet, the diameter would be about $6\frac{1}{2}$ feet. Armstrong would divide this space equally between the steam and water, while Bourne would give three-quarters of the boiler room to the water and one-quarter to the steam. If the water could be supplied so as to come properly in contact with the heating surface, and the steam taken in a steady stream, but little boiler capacity, comparatively, would be required; and these conditions have been somewhat realized in certain coil boilers. Large boilers may serve as a storage for steam, so that as steam is taken away intermittently the variation of pressure will be small, but steam cannot be raised in them so quickly as in a small boiler. If large, the first cost will be quarter, and if too small, although the first cost will be less, there may be a loss in its use, as it may be necessary to force it continually, producing a waste of fuel. There is no definite rule for determining the boiler room, and in our example we will let it be determined chiefly by the required amount of heating surface.

The area of the grate is, in some respects, a controlling element—at least, it may be made the element of reference. Its correct size will depend upon the amount of coal to be burned, and the amount that can be burned per square foot of grate. The necessary amount to be burned per hour cannot be determined exactly beforehand. The heat units developed by the complete combustion, if pure carbon, is 14,500, as determined by experiment, but commercial coal does not contain nearly so much heat, 11,000 heat units being nearer the correct value; and if our boiler utilizes 0.8 of the the heat of the coal, then 8,800 heat units will be available for producing steam. But the experiments of Regnault showed that it required 966 heat units to evaporate one pound of steam at 212° F., when the feed water was 212° F.; hence, one pound of our coal will evaporate $8{,}800 \div 966 = 9.1$ pounds of water, the feed water and the steam being at 212°. As the pressure in our boiler is to be 100 pounds gauge, the temperature will be 338° F., and and if the feed water be at 100° F., the evaporation per pound of our coal under actual conditions will evaporate $9.1 \div 1.15 = 7.9$ pounds, and as 3,200 pounds are required per hour, the coal required per hour will be $3{,}200 \div 7.9 = 405$ pounds. We omit the fractions in the larger numbers, as they are of small importance in this case. According to this result, there will be required a little over 4 pounds of coal per horse-power per hour. With better coal, higher initial pressures, the best condensing engines develop a horse-power with less than two pounds of coal per horse power per hour, and if these conditions should obtain in our design we would reduce the number: but for the conditions we have assumed, we will retain our result, 405 pounds. The amount of coal which can be burned on a square foot of grate depends largely upon the draught.

(To be continued.)

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EFFICIENCY OF ENGINES.

ALL forms of steam engines have been made. Given, a sliding, rotating, oscillating, vibrating, or any other piston in a closed chamber, and it will move by steam if sufficient pressure is applied: but no type of engine has shown the efficiency or power developed for a given weight of steam, that the reciprocating piston (horizontal or vertical), transferring its power through a connecting rod on to a crank, has. That is why they are so universally used. The whole question of the value of any given type of engine is settled, so far as economy is concerned, by its efficiency, and this being determined, no other has weight. Persons who do not bear this in mind are forever inventing various ingenious forms of steam machines with sliding partitions, curious valves, and dodge around-it steam ports, thinking that these, in some mysterious way, will make up for loss of efficiency. They will not, for efficiency depends upon the laws of motion and upon the mechanical arrangement of parts secondarily. Steam has found this out and will do more work for less money upon a reciprocating piston and a crank than in any other form of engine yet known.

FAMOUS AMERICAN ENGINEERS. NO. 7.

Horace See.

Horace See was born in Philadelphia, July 16, 1835. He is the son of R. Colhoun See, who was senior member of the silk importing houses of See & Remington, and See Brothers of Philadelphia. Horace See received a classical education in the Episcopal Academy and the academy of H. D. Gregory of Philadelphia, and served a regular apprenticeship of four years with I. P. Morris & Co., of Philadelphia, the early part of it being spent in the machine shop and the latter part in the drawing room. After the completion of this apprenticeship Mr. See engaged with Messrs. Neafie & Levy, of Philadelphia, first as chief draughtsman, and latterly as superintending engineer. This was during the transition period, when wood was giving way to iron, and the jet condenser to the surface condenser. The '*Saxon*' and '*Norman*' of the Winsor Line, '*Liberty*' of the Havana Line, the '*Pontiac*,' U. S. N., and others used as transports, etc., during the war, also the '*Nuevitas*,' '*Oriental*,' tug '*Charles Pearson*' and others, the hulls of which were of iron and built as well as engined by Messrs. Neafie & Levy, all came under Mr. See's charge. Mr. See then engaged with the National Iron Armor and Shipbuilding Co., of Camden, N. J., first as assistant superintendent and latterly as superintendent. During this period the U. S. monitor '*Koko*,' Ss. '*Pioneer*,' '*Sheridan*,' etc., were built and engined. In 1868 Mr. See was engaged with Mr. Geo. W. Snyder, of Pottsville, Pa. as engineer and assistant superintendent, designing and constructing the machinery for the Lehigh and Susquehanna planes at Wilkesbarre, Penn., and the hoisting and pumping machinery for prominent mines in the anthracite coal regions; the valve gear of the Bull pumping engine now extensively used in those regions being Mr. See's design. Mr. See in 1871 connected himself with Messrs. Cramp & Sons, of Philadelphia, as chief draughtsman when that concern began building iron vessels and their engines, the first vessel being the '*George W. Clyde*' which was fitted with the first really successful compound engine built in this country, and is to day running in fairly good condition. The steamers '*Pennsylvania*,' '*Ohio*,' '*Indiana*' and '*Illinois*,' of the American Line, succeeded this vessel. In the design of this work and what followed, Mr. See took a prominent part, and in 1878 accepted the position of superintendent engineer, when his field of operations expanded and the construction of the machinery in the shops and its erection in the vessels came under his supervision, in addition to the original conception and design of the work. From this time a great variety of work was turned out, including merchant vessels, cruisers, yachts, excursion steamers, ferry and tugboats, propelled either by paddle wheels, single or twin screw propellers. These comprised single, double, and triple-expansion engines, of the vertical, horizontal, diagonal and oscillating types, having one, two, three and four cranks. Some with and some without steam jackets, and using puppet, gridiron, plain slide, and piston valves, with Stephenson, Stevens, Corliss, Meyer, and Marshall valve gears.

The machinery of the following vessels was designed and (with the exception of a few now being completed) superintended by Horace See:

Yachts '*Atalanta*,' '*Corsair*,' '*Stranger*' and '*Peerless*;' Ss. '*Chalmette*,' '*El Mar*,' '*El Monte*' and class of the Morgan line; '*Queen of the Pacific*,' Ss. Co.; '*Mariposa*' and '*Alameda*,' Sandwich Island line; the '*Tacoma*,' '*San Pedro*,' and '*San Pablo*' of the Central R. R. Co.; the '*H. F. Dimock*,' '*Herman Winler*' and '*H. M. Whitney*,' Metropolitan Line; the '*Caracas*,' '*Valencia*,' '*Philadelphia*' and '*Venezuela*,' of the Red D. Line; the '*Mascotte*' and '*Olivette*,' of the Plant Line; the '*Cherokee*,' '*Seminole*' and '*Iroquois*,' Clyde's Line, New York; the '*Monmouth*,' of the N. J. C. R. R. Co., and also the U. S. N. cruisers '*Philadelphia*,' and '*Newark*;' gunboats '*Yorktown*,' '*Concord*' and '*Bennington*;' and dynamite cruiser '*Vesuvius*.'

Many improvements were introduced by him, Mr. See, one of the leading being the fitting up of the crank-shaft, perfecting its bearings in the shop, and their alignment in the vessel. This method has done much to improve the working of the engine, as well as to reduce the amount of wear and minimize the risk of breakage. The engines with shafts fitted in this way are in condition to run without giving trouble from this source, although driven at their utmost speed, during the first trial of the engines or voyage of the vessel. The manner of doing this was presented by him in a paper before the American Society of Mechanical Engineers, and the method and tools employed are covered by patents in this country.

Mr. See at an early period advocated the employment of the triple-expansion engine, presenting a paper on this subject before the Engineers' Club of Philadelphia, in June, 1884, where he showed the economy of this type of engine and the necessity for limiting the range of expansion and temperature in each cylinder of a steam engine during one stroke. He also took the ground that the steam jacket was not a necessity in an engine with a moderate revolution speed, and that if the same amount of steam was used in the first cylinder instead of in the jacket the same economy would follow, together with the elimination of a costly and trappy device.

In the engines of the United States Navy cruiser '*Baltimore*,' Mr. See recommended several changes, a prominent one being an adjustable shoe on the under side of the main pistons to take the weight, and leave the packing rings the duty of preventing the passage of steam past the pistons. The performance of this piston has been eminently satisfactory.

Horace See is a practitioner in the broadest sense of the word, taking the engine from its inception to its final trial; exact in everything that pertains to the work under his supervision; bestowing careful thought on what he has in hand before making a beginning, so that the finished article differs but little from the original design.

Mr. See was instrumental in having the U. S. Board of Supervising Inspectors make the spring loaded safety valve allowable on merchant vessels without the additional employment of the lever valve; also in having the present rules for the corrugated boiler furnace adopted, as well as preparing the rules now in use for the staying of boilers. Mr. See is ex-president of the American Society of Mechanical Engineers, fellow of the American Society for the Advancement of Science, member of the Franklin Institute, associate member of the U. S. Naval Institute and also a member of the Engineers' Club of Philadelphia and the Engineers' Club of New York. He resigned his position with Messrs. Cramp in August last, 1889, and is now located in this city as Consulting and Superintending Engineer, occupying the position of Consulting Engineer of the Chesapeake Dry Dock and Construction Company at Newport News, Superintendent Engineer of the Morgan Line, and Consulting Engineer for other parties.

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EXIT MANUAL TRAINING SCHOOL.

Considerable comment has been caused lately by the decision of the school board of one of our large cities to stop the practice of requiring school children to devote a portion of their time to what is known as industrial education. There was great agitation a few years ago in favor of this industrial education, and the impression was sedulously circulated that the workshop was getting obsolete as a place for imparting mechanical training, and that it must soon give place to the school and the college. Under the influence of this sentiment changes were made in educational establishments to render them training schools for trades. The minds of children were diverted from the lowly pursuit of the three R's by periodical calls to play at workshop in some dingy cellar or littered workroom, and students of higher degree were deluded into the belief that by deserting their books for an hour daily to trifle with lathes and planers that they would acquire an engineering training that would commend them as leaders in industrial pursuits. It is doubtful if the children or those of more advanced years have profited any by the would-be training, and the workshop still continues to send out the men who become foremen, managers, and proprietors of manufacturing establishments.

What the friends and advocates of an improved system of industrial education ought to do, is to provide means whereby the workman may acquire scientific knowledge relating to his business. The tendency of the system of higher industrial education that has been carefully fostered for several years is to turn out scientific experts with no practical knowledge. Men with this one-sided training are of less value to themselves and to the country than the common workman who has the practical training, pure and simple.

If there were more good evening industrial schools where young, ambitious workmen could acquire training in the science of their business, it would confer great benefits upon our working community, and upon the prosperty of the country at large.

Amicus.

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A Newark subscriber wishes us to explain this paragraph in the last issue:

> "It has long been known to every sea-going engineer who understands his business, that the most economical vacuum is not measured by the greatest number of inches of mercury. A high vacuum means cold feed-water, and a rise of a few degrees in the temperature will often much more than compensate for the power assumed to be lost. Thus, for instance, a condenser temperature of 100 deg. corresponds to a pressure of less than one pound per square inch," etc.

High vacuum requires a great deal of condensing water, which is, therefore, not so hot to feed to the boiler as where less water is used to condense the exhaust. "Pressure in the condenser" means pressure above a perfect vacuum, which is 29.4 pounds or inches. If there is only 26" vacuum in the condenser, there is a pressure in it equal to 4.4 pounds as compared with absolute vacuum.

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A man is happiest when he can forget all the mean things he knows about himself.—*Troy Press.*

Foreign and Domestic Trade Literature.

ENLISTING IN THE NAVY.

"Nearly every boy who enlists in the navy does so, not because he wants to become a sailor particularly, but because he has a hankering to see foreign lands. He has read all sorts of stories about the wonderful things to be seen in other countries than his own, and his youthful mind is fired with the ambition to look upon all these things himself. After two or three years' service, all the gloss and newness having worn off, he repents. Work before the mast is not like traveling with plenty of money. When the boy finds upon reaching a foreign port that he is allowed just so many hours a day on shore, and that there is very little to be seen by one who has not learned where to look and who has not the money to acquire such information, then he feels that possibly there isn't so much fun in that sort of travel as he had expected.

"For the first year or two the mere knowledge that he is seeing different countries satisfies his mind, but after that he wishes that the period of enlistment was not quite so long and that the ship would turn her prow homeward. All of them get to think after a while that there is no place like home. Perhaps as important a feature in bringing about this result as any other is the way in which he obtains his sleep on board the ship. It is quite a different thing from what he has been accustomed to on shore. The sailor has to get up in the middle of his sleep in the dead of night and take his turn on duty, no matter how tired he may be. He never has one long, unbroken rest, as on shore, but must take his sleep by snatches. Almost the first thing that one hears from the sailor when he learns that the ship is going home is: 'Oh, I'll be glad when I get home and have my nights in again. Then I'll be able to stay indoors all night and have a good, solid sleep.' That is it. His 'nights in' are what he cares more about than anything else. On shipboard it is always 'nights in and out.'

"As a rule a naval apprentice will not reenlist right away after his first term of service. A good many will come on shore and stay there for five or six years, when a hankering for the sea will come over them, and they will turn out for enlistment again. If they enlist twice they are pretty sure to stick to it, and then they become 'shellbacks.' A good many officers of the navy think that it is a very good thing that the apprentices don't re-enlist. They argue this way: The best possible use to which our navy can be put during times of peace is to make it a training school for young men. During their five years of service the apprentices learn practically all that it is necessary to know of the work in the navy, both practical and theoretical, and they will never forget it. Now, there are only a certain number that can be taken, and if the same ones remained in the navy all the time there would be no room for newcomers. As it is at present, the old ones go out and new ones come in, and in that way a large number of experienced seamen come into being who will be of the utmost service to the nation in case of emergency. There is no question about it that the young man who has served his apprenticeship, and who has left the navy because he has seen all that can be seen in times of peace, will be the first to turn up for war. Boys of good character, who have no physical defect and who can read and write fairly well, are admitted into the American navy between the ages of fourteen and eighteen years. Between fourteen and fifteen years a boy must measure 4 feet 9 inches in height and weigh not less than 70 pounds; between fifteen and sixteen years, 4 feet 11 inches and 80 pounds; between sixteen and seventeen years, 5 feet 1 inch and 90 pounds, and between seventeen and eighteen years, 5 feet 2 inches and 100 pounds. They must serve till the age of twenty-one as boys or junior seamen, and after that age they rank as seamen or petty officers. They are now allowed a sum of $45 for outfit, a fact which considerably enhances the advantages of the service. To discover the exact number of petty officers on board a fully-equipped ship is a puzzling affair; but, at all events, the number of these minor prizes is encouragingly large, while still higher up, as the final goal of the common sailor's aspirations, are the four warrant officerships—held by the boatswain, the carpenter, the gunner, and the sailmaker—whose pay and privileges, mark it well, are the same as those of the junior officers.

The pay of boys enlisted as third-class apprentices is $9 a month; the next promotion, to second-class, brings $10; the next, to first-class apprentice, $11 a month. Further on we have second-class seamen apprentices, with $19 a month, followed by first-class seamen apprentices, with $24 a month. The latter two grades correspond respectively to ordinary seamen, and able seamen or simply seamen, whose pay is also $19 and $24. We can thus see that a first-class seaman, apprentice, or a seaman, receives $288 a year, which is $128 in excess of the highest paid to a first-class seaman in the British service. There is, besides, the daily ration of 30 cents, which runs through the ship from the apprentice to the commander, for, strange as it may appear, Uncle Sam distributes just the same quality of loaf to the officer as to the apprentice, and that, too, only when on sea duty. There are no other allowances made to the officers whatsoever; they have to furnish all their own mess equipments and everything else, and all their entertaining—often a heavy item in their expenses—has to be done by private money.

Any ordinary boy, then, who joins the American Navy, has it in his power to become some day a warrant officer, wear a handsome uniform, and draw substantial pay and rations while visiting the four quarters of the globe in the service of his country, and, of course, fighting her battles if need should arise. Suppose he does not attain to warrant rank; there is still the middle grade of the petty officer, who receives from $27 to $70 a month, and can retire with a pension after thirty years' service.—*N. Y. Times.*

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ELASTICITY.

Nearly all solids, and certainly all metals, are elastic up to a certain point, that is to say, until a certain stress is brought to bear, after which they either become ductile or break.

The elasticity of solids is in two directions—elasticity under extension, and elasticity under compression. Liquids and gases have only elasticity under compression.

The vital difference between the elastic force of solid bodies and the elastic force of fluids may be expressed thus: Fluids possess elasticity of *bulk;* solids, elasticity of *form.*

When the elastic force of steam drives a piston, the force is due to the effort of the steam to occupy a larger space, the steam having, so to speak, no partiality in the matter, so that whether the cover is blown off, the sides of the cylinder split, or the piston moves, it makes no difference to the steam.

Increased bulk in any direction, or by any means will alone satisfy the expansive energy of steam or other elastic fluid.

Gases are said to have the property of "indefinite expansion," which comes to the same thing as saying that you cannot reduce the elastic force to zero, no matter how much space you give it.

The pressure which a gas exerts upon the sides of a vessel containing it can be accounted for by supposing the molecules of the gas to be perpetually in motion, flying about and colliding with each other, and cannonading against the sides of the vessel and rebounding again.

The velocity with which the molecules are flying about in all directions becomes a matter of calculation.

A velocity of 1,600 ft. per second in the particles of oxygen and nitrogen, which constitute the atmosphere, is sufficient to account for the ordinary atmospheric pressure of 14.7 lbs. per square inch.

A velocity of 2,500 ft. per second in the particles of water which constitute steam, is sufficient to account for a pressure of 150 lbs. per square inch in a steam boiler.

The elastic force of water is very great, but it must first be compressed if we are to get any elastic force out of it, and the force necessary to compress water appreciably is so enormous, that in all ordinary engineering calculations water is treated as incompressible.

A glass tube about half full of water, from which every trace of air has been expelled by continued boiling, behaves very much as if a solid lump of metal were contained in it. The water strikes the end of the tube when shaken up with a sharp crack, which has earned for the apparatus the appropriate name of "water hammer."

This experiment does not prove water to be incompressible or devoid of elasticity, but only that its elastic force is very high, when not masked by a cushion of air.

To observe the elasticity of solid bodies it is most convenient to alter their *form* rather than their *bulk.*

When a piece of india-rubber is stretched it becomes thinner and the bulk remains unaltered. So also when a steel spring is bent, it is the *form* that changes, and the effort of the steel to recover its original form constitutes elasticity.

When a batten of wood is bent to any considerable extent, it is quite obvious that the convex side becomes longer and the concave side shorter than the original length. But it is not so easy to prove that the same thing happens to the most delicate watch-spring; and yet we know it must be so.

We cannot bend even a hair without one side being stretched, and the other side being compressed an equal amount.

The resistance to bending is thus seen to be merely a resistance to stretching and compression; and the elasticity of a bent spring is made up of the elasticity of the material in extension and compression acting as a couple to straighten the spring.

The useful applications of the property of elasticity possessed in a high degree by tempered steel does not need pointing out; but it may not be amiss to observe that to the elasticity possessed in *some* degree by all materials employed in structures, do we owe the safety of those structures when subject to strains in ordinary work.

No structure could stand for a moment—no steam engine could make a single revolution without breaking down—were it not that the parts are continually giving and taking under their varying loads.—*A. N. Somerscales.*

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MODERN SNOW PLOWS.

The Cyclone is the largest and widest snowplow yet built, making a path 10 feet 4 inches in width. Its capacity is something marvelous. It will throw out 130,000 cubic feet of snow per minute. The car is 48 feet long. Within the cab are three engines of 600 horse-power each, or a combined force of 1,800 horse-power. Two of these engines drive the fan which expels the snow. The third one connects direct with an auger, which draws the snow into the cylindrical case in which the fans revolve. The discharge pipe is 33 inches square, the spout being 14 feet above the rails. This throws the snow almost pependicularly for 30 feet before it begins to curve in its fall, clearing telegraph poles with ease.

It has a flanger on the front end, and gathers the snow from the center of the track and from each side of the rails, taking it into the inner portion of the plow, whence it is expelled through the spout on the top, leaving a perfectly clear rail. The plow weighs 75 tons. In is entirely under the control of the engineer, who stands at the front end, on the inside, and operates the throttles and communicates with the pushing engineer by the use of his whistle, without having any gongs, signals, or bells, as is customary on rotary plows. The engines are capable of working 700 revolutions per minute, and, being connected directly with the fan and auger, it is possible to revolve them with the same rapidity.

The inventor of the Cyclone steam snowplow, E. P. Caldwell, of Minneapolis, Minn., is general manager of the Duluth, Huron and Denver railroad, and has large experience in railroading, having worked himself up from a locomotive engineer to his present position. Speaking of the general workings of the Cyclone, Mr. Caldwell said: "On approaching a snow bank the large auger at the front is put in motion, and its tendency is to draw the snow into the auger, passing it back into the fans, whence it is thrown out through the spout on top to either side desired.

"We passed through snowbanks on the Pequot Mountains, ranging from 10 to 14 feet in depth, and the snow was hurled a distance of from 100 to 175 feet down the mountain side. When we arrived at Truckee, the plow was put to work clearing out side tracks. Here we came in contact with the worst kind of snow, which had been shoveled and thrown off the sheds and from the main line to side tracks, and which was three-fourths ice. The snow averaged from 8 to 12 feet in depth. The plow passed through the side track, a distance of 1,500 feet, in ten minutes by the watch, hurling the snow a distance of 250 feet, breaking out the glass in the roundhouse and covering up small cottages on the side near the track. It was estimated by the gentlemen who witnessed the working of the plow that it would have taken 200 men four days to have cleared this side track of snow with shovels, and we cleared it in ten minutes.

"We next tried the plow on a side track. Here the snow was frozen nearly hard and ranged from 8 to 12 feet in depth. This track was about eighteen hundred feet long. We cleared it of snow in fifteen minutes, throwing it over the top of large buildings and breaking windows at hotels and stores on the business street, two hundred feet from the track.

SMOKELESS POWDERS AGAIN.

MUCH mystery has surrounded the nature and origin of the first smokeless powder adopted by the French Government, for use with the Lebel magazine rifle. A few particles seen about two years ago were in the form of small, yellowish-brown tablets of the thickness of stout note-paper, and had evidently been produced by cutting up thin sheets of the material. They appeared to contain picric acid (the basis of "mélinite"), a substance extensively used as a dye, one of the earliest of known explosives of organic origin. When sufficiently heated, or when set light to it burns with a yellow, smoky flame, and very large quantities of it have been known to burn away fiercely without exploding. Under certain conditions, however, it explodes with great violence and highly destructive effects, as first pointed out by Sprengel in 1873, and recent experiments at Woolwich have shown that it does this even, as in the case of gun cotton, when it contains as much as 15 per cent. of water. It is no longer a secret that picric acid, at any rate, forms the basis of the mysterious explosive for shells for which the French Government were said to have paid a very large sum of money.

M. Nobel, to whom we owe the invention of dynamite, was the first to apply the latter explosive agent, in conjunction with one of the lower products of nitration of cellulose, to the production of a smokeless powder, bearing great resemblance to one of the most interesting of the violent explosive agents invented by Mr. Nobel, called blasting gelatine. When the nitro-cotton is impregnated and allowed to digest with from 7 to 10 per cent. of nitro-glycerine, with the aid of heat, the whole soon becomes converted into a plastic material, from which it is very difficult to separate a portion of either of its components. By incorporating with nitro-glycerine a much larger proportion of nitro-cotton than used in the production of blasting gelatine, and by employing camphor as an agent for promoting the union of the two explosives, as well as, apparently, for deadening the violence or reducing the rapidity of explosion of the product, Mr. Nobel has obtained a material which can be pressed into pellets or rolled into sheets while in the plastic condition, and which compares favorably with the gun-cotton preparations of somewhat similar physical characters just referred to, as regards ballistic properties, stability and uniformity, besides being almost absolutely smokeless. The retention in its composition of some proportion of the volatile substance, camphor, renders this explosive liable to undergo some modification in its ballistic properties in course of time. It is believed that this point has been dealt with by Mr. Nobel, and accounts from Italy speak favorably of the results of trials of his powder in small arms, while Mr. Krupp is reported to be carrying on experiments with it in guns of several calibers.—*N. Y. Times.*

HOW ENGLISH ENGINEERS ARE FOUND.

To the credit of many steamship owners it must be recorded that they have provided their engineers with as good accommodation as circumstances would admit, that they allow the shipmaster a sufficient sum per day to provide an adequate supply of food of the best quality, and that knowing the value of a good and contented engineer, they will not part with a man for a difference of a pound or two a month, consequently their engineers are contented, and prove that they are grateful for considerate treatment by making it a matter of professional pride to show how well they can run their ships and at how little cost. But the other side of the picture reveals a most painful contrast. On it we find in many cases two engineers, who are officers in charge of men and presumed to be gentlemen, consigned to a den measuring seven feet in length by four in width, as their home for months. The fittings consist of two shelves, twenty-one inches wide, upon which these officers are supposed to sleep, a twenty-six inch seat-locker at one end and a chest of drawers the same size at the other, over which may be a ten-inch looking-glass, and a swinging oil lamp, with sometimes a water bottle in a rack in the corner and sometimes not. The washstand arrangements are to be found in the stoke-hole, and consist of any of the water buckets in use there which the engineer may select and clean out (should it have previously been used in the bilges), and such is the accommodation with which engineers have put up for years, and still occupy in many a ship. In the mess-room, which perhaps measures four or five feet in length by four in width, there is a ten-inch board along each side to serve as seat, two of these boards joined form a table; overhead are racks for crockery and utensils, and underneath are stowed sundry miscellaneous articles required by the steward (when there is one) for cleaning out the dens when they become too dirty to be longer endurable. At dinner time the table is laid with a cloth of a decidedly neutral tint (when there is one to lay), and hoop-iron bone-handled knives, two-pronged forks, pewter spoons of leaden hue, plates of the coarsest quality, sometimes a four-hole cruet stand, a spare tea cup containing salt, and a two-penny tin pepper box complete the display. The food consists of soup made from salt pork and split peas, or some other equally cheap vegetable—the pork itself hard and dry—and watery potatoes, followed by a dessert of ship biscuit, spread with butter, if there is none, eaten without. This is varied by the substitution of salt beef for salt pork on alternate days; but the quality is the same, and the same routine is kept up day after day, remonstrances being met by reference to the ship's articles. For this inferior fare it may be that the owner is paying three times its value, and feels quite satisfied that his ships' crews are well catered for, and ought to be happy and contented. In such a case it is not the owner's fault, but the engineer has to suffer all the same.—*Engineers' Gazette.*

AN OBSERVING ENGLISHMAN.

THIS is how we look to an observing Englishman: "The ordinary American cars are of one class to which all have access. Hence the door is always on the bang. Nor is this banging of doors confined to the passengers. The conductor goes through every car after a stop at each station, collects the tickets, and departs, banging the doors after him. He is followed by the brakesman, whose duty it is to attend to the fire, and announce the name of each station. He bangs the door, too. Then comes the youth with the newspapers. These he disposes of and disappears with a bang; ere long he re-enters, this time as a vender of apples, and, as before, he departs with a bang. He returns again with serials, these he places on the knees of the passengers or on vacant seats near them, hoping that some may be induced to buy, and again takes his departure. After a decent interval he reappears to collect his scattered goods and receive payment for the literature. His next visit will be in charge of candy and chewing gum—articles most agreeable to the American palate—his next with grapes and pears; and by that time the turn of the papers has come round again, and the round of banging continues steadily. Then, as if this incessant banging were not enough for the toughest nerves, there is frequently added the intermittent squall of a baby, or the whistling or kicking of a small boy, or the impatient stick-tapping of an irritated traveler. * * * And now as to the American system of dealing with luggage. When the luggage has been weighed your receive a brass ticket with a number punched on it for each piece, and a corresponding number, with a chain attached to it, is fastened to the piece in question. A representative of the express company of the city to which you are going appears in your car some half hour before your arrival at your distination. You make your bargain with him, obtain your receipt, hand him your checks, which he slings on a great brass ring on his arm, and do not trouble yourself further about your property. It will usually be delivered at your hotel about an hour or an hour and a half after you reach it. It is almost impossible for any ordinary traveler to get his luggage out in a reasonable time unless he follows the universal system. This arrangement is more suited to American traveling than it would be to the hurry and scurry of English lines. I think the ordinary Englishman prefers to wait a few minutes, enlist the services of a friendly porter, seize his goods as they are tumbled out of the van, get them placed on a handy hansom, and carry them off himself to his abode. He would hardly care to sit kicking his heels at home, waiting for his property to be delivered by the express. Moreover, there is another reason for the express, which does not yet apply so much in England. The Americans carry a small hand bag, which suffices them for the time, and their other goods are deposited, not in portmanteaux or ordinary boxes, but in mighty cases called Saratoga trunks, bound with tin, or iron, or brass, which it takes a couple of men to move, and which would be too heavy for an ordinary cab. On the whole, then, I may say that the system in vogue in each country would hardly suit the other."

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AFFLICTIONS show us that all mankind is one great family, and that the sorrow of one is the sorrow of all acquainted with the bereft.

COMPOUND LOCOMOTIVES.

In a discussion upon compound locomotives at the Institute of Mechanical Engineers, England, the president, in closing the discussion, said that, considering the relative merits of the single cylinder and compound systems, the conditions under which the engines worked must be taken account of. For marine engines, and for all engines the work of which was regular, the compound was beyond doubt the better system. But for locomotives the advantages were not so clearly apparent. The work of a locomotive was of the most irregular character. As for the saving in fuel, it was difficult to see how it could be greater than about 15 per cent. at the best. The wear and tear in the compound must certainly be greater than in the non-compound. Possibly not much greater; but it was vain to look for less. There was a source of error in estimating the saving of fuel that more or less vitiated the conclusions drawn from observed facts. He would explain what he meant by quoting instances. Two men were set to drive in turn the same engine over the same line, and in the same circumstances. One always burned 32 lbs. of coal per mile, the other never exceeded 26 lbs. In 1847 he, with others, selected eight drivers, and to each of these in turn the locomotive was entrusted for three days, twice repeated. The difference between one man and another in fuel consumption was as great as 22 per cent. Now, if the compound was not run by the same man who drove the non-compound engine, we did not know to what the saving was attributable.

Mr. Tompkins said, that the power developed by the compound engine appeared to be 15 to 20 per cent. less than when the engine was not compounded, and a like percentage of economy was obtained, so one effect should be put against the other. In judging of the economy of repairs it should be remembered that the engines, when compounded, were just out of the shops, whilst the others had been running some time.

[Seven or eight years ago in this paper we took the same position as that recorded above as regards compound locomotives, and see no reason to change it yet.—Eds. Engineer.]

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REPAIRING A BREAKDOWN.

The Ss. '*Garlands*' left Baltimore, Dec. 13, bound to Sunderland, and all went well until the 26th, when, during a strong gale of wind, with high cross seas, and the ship laboring heavily, the connecting rod of the low pressure engine broke without the slightest warning, completely disabling that engine, and what was worse the main-pumps being driven from that engine were thereby rendered useless. The engineers proved equal to the emergency, and immediately disconnected the low-pressure engine, removed a slide valve chest cover, and fitted a wooden exhaust pipe through the skylight, intending to work the other two engines at high pressure until such time as there might be some improvement in the weather, when they could try other remedies.

In the meantime they started the donkey feed-pump and everything appeared to work well for about an hour, when the connecting rod of the donkey broke, thereby rendering it useless. The engineers thereupon took down the disabled rod of the low-pressure engine and removed the top end pin by cutting it out, to prevent damaging it, and they also took down the high-pressure connecting rod and removed the pin from it by heating and with a big hammer, and fitted the pin of the low-pressure rod into the eye of the high-pressure rod, and put the high-pressure rod in the place of the disabled one, coupling it up and getting the pumps once more connected, made the low-pressure engine again of service. After removing the temporary wooden exhaust pipe and putting the cover again in its place, they endeavored to secure the high-pressure piston, and remove the valve, thereby converting the triple-expansion engine into an ordinary compound. Another attempt to proceed was then made, and this time with great success, and having now the use of all the pumps, proceeded very slowly at first, making about 6½ knots per hour for two days. On applying the indicator and taking a few tracings, which showed some defects, these were soon remedied, and the speed was increased gradually until the ship made 7½ knots, at which speed she safely reached her destination, a distance of about 1,500 miles, without assistance of any kind.

Every credit is due to the chief engineer, Mr. David Short, and his staff for the promptitude they displayed in turning to account the resources at their command, and the care with which they proceeded in affecting a temporary repair of the machinery under such trying circumstances, and we may commend this case to the consideration of ship-owners as another illustration of the advantage of employing only engineers of competency in their ocean steamships.—*Engineers' Gazette.*

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HOT FIRE ROOMS.

Forced draught may no doubt be lauded as a cure, but we could name one large ship fitted with forced draught in which the temperature between the boilers reaches 160°. The close stokehold system has the advantage over the closed ashpit system that air in quantity is sent into the fire rooms. But even in this case sufficient care is not always taken to distribute it, and the result is that there are places into which men must go, and in which they must work, which are much too hot. Besides, it is not in boiler rooms alone that the heat is too great. The high-pressure end of the engine room of an Atlantic racer is not too frigid a locality; while electric light engines are stowed away in corners now and then "hot enough to melt the white metal out of the brasses." Now all this could be easily avoided with great advantage, not only to the engineers and the firemen, but to the owners of the ship, by providing fans for ventilation; and care should be taken to make these fans draw cool air, and not as in one case which recently came under our notice, in which the fan drew air heated already to a high temperature by the uptake. When the air has been got below, measures should be taken to distribute it; and this is by no means difficult. Improvements in this direction are, we are glad to say, being made every day. The '*Teutonic's*' fire-rooms were found to be excessively hot because the furnaces are fitted with a modification of Howden's system, and there was consequently nothing to change the air in the stoke-holes. Messrs. Allen are now constructing fans and engines, which will be used to provide fresh cool air, not for the use of the furnaces, but the firemen. Her engine rooms were fitted from the first with fans and wind trunks for distributing fresh air on the platforms. In the '*City of New York*' a pipe leads close to the place on the starting platform on the crank floor where the engineer stands, and delivers cool fresh air to him at will.—*London Engineer.*

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"I have worked in shops where all have a share—one on the output per machine or article turned out, another upon the economical working of plant, another for the invention of better mechanical appliance, and another upon stores and general engines. In one instance of a firm where I was working a saving of £18,000 in the half year was said to have been effected, and 5 per cent. was demanded. I know how this was done, and what followed. Jobs for which a piece-work price of £40 was paid were eventually cut down to £6. The systematic overtime that was kept on year after year, for nothing else but to keep up the prices to make pay all round, was suddenly stopped. Hence the saving."—*Mechanical World.*

DOWN-CELLAR ENGINEERS.

Engineers are not made, they make themselves every time. But by putting too much stress on this statement of a fact they sometimes make mistakes instead of engineers. The book engineer—the man who knows just how to do it, because he has read it and figured it all out—is the bugbear of the practical man who has learned his business in the fire-room and engine-room, and holds his credentials by virtue of the scars of service. When the practical man has thought so far as this he should guard against the mistake he is likely to make, viz: that of thinking he can get no good in the line of his work from reading and study. This is a serious blunder. Let us see. Without doubt an engineer must learn his duties in the engine-room. All the theory in the world about combustion, for example, will not teach him how to manage a fire and keep up steam. These are things that must be learned right where fires are managed and steam is kept up. But reading a good, plainly written article, by some one who has been right where the engineer is, will help any engineer, no matter how well posted he may be.

Learning to be an engineer is not a bit different from learning to be a machinist, or a boiler maker, or a doctor, or a lawyer. If a man essays to follow either of these trades or professions, and makes up his mind that he will dig out all there is of it by himself, ignoring what others have done and are doing, there never will be very much known about his successes. He will not have any successes to speak of. If an engineer expects anything different from this he is morally certain to be mistaken. Things are not done in that way in these years of grace.

When a young man starts out to be an engineer, circumstances may locate him in some dirty cellar, but it don't follow that he need stay there all his natural life. His ambition ought to be to get out of that cellar into better surroundings, but to do this he must not only work with a view to learn all he can, but he must read with a view to learn about the surroundings of others. He must get together what he knows, and supplement it with a good deal of knowledge that others have gained. If he sits down by his little wheezy engine, and his dirty boiler, and steam-gauge that no one knows anything about except that it has a pointer and a presumable connection with the boiler, sits down alongside his pump that works when it is in the humor for doing so, sits down contented by day and by night, never subscribing for and reading a paper that will set his brain working, never spending a dollar for a book that will give him knowledge of things he knows nothing about, if he does these things with sufficient vigor he will never get out of that low, dirty cellar. He don't deserve to get out of it; it is the place for which his talents are best suited, and he ought to stay there because he has a desire to that end.

The cellar is typical merely. The case is the same whether this young engineer is getting acquainted with a stationary engine, or having beat into him the mysteries of running a marine engine or a locomotive engine. If he never improves his surroundings, and above all if he never assists his vision to penetrate what there may be beyond these surroundings, he will stay in the cellar all his life. There may be sunlight outside, but the man who has no desire to see the sunlight is never troubled with its glimmer. * * * *

In these days there is no excuse for an engineer who is ignorant. There is no reason in the world why he should not get all the knowledge he is capable of holding in relation to his business. It is almost as free as air. He will not have to learn Greek nor the higher mathematics to get this knowledge. All important facts in relation to steam engineering are told by the very best writers in language as plain as that of the common school.

Engineers make themselves. If an engineer elects to stop in an inferior position —in the cellar—there is nothing that will prevent his doing so; if he has a desire to climb above the lower rounds of the ladder there is no power in the land that will hinder him.

To-day the demand in everything is for better workmen. No one is just satisfied with existing conditions, and it is a good thing that this is so. The fact that everybody wants something better means advancement, and somehow or other, when a man really does advance in knowledge he finds a place to drop into that is in advance of the one he previously occupied.

In the foregoing, there has been no intention to single out engineers as a class as worse than other workmen. They are no worse than machinists, or carpenters, or other skilled mechanics. There is danger that all of us may get sleepy, and forget that the world never stops moving to let us sleep. Whatever the occupation of a man may be he must move along to keep up, and no man can do this unless he thinks and studies about things beyond his everyday sight.

Better engineers in every branch of the business are needed. Sometimes an instance may occur in which it may seem that they are not wanted, but these are only the exceptions that obtain against all rules. There need be no hesitation in saying to engineers, "Push ahead; get knowledge of your business and you will find opportunities to use it." When some one —no matter who—wrote "Knowledge is power," or words to that effect, he made no mistake. * * * *

LATEST FACTS ABOUT ALUMINUM.

FREMY gives the specific heat of aluminum as 0.2181. Aluminum follows the general rule of specific heats—that they are inversely as the atomic weights. The coefficient of linear expansion, as determined by one of the authors of this paper, of rolled rods of aluminum of the "average lot" Pittsburg Reduction Company of 98.52 per cent. aluminum, is approximately per degree centigrade between the freezing and boiling points of water as .0000006 that of iron by the same method being .0000122 From this it is apparent that aluminum has a coefficient of expansion closely approaching that of tin, which is .0000217 and higher than copper, which is .000017182 Sound castings can be readily made of aluminum, using dry sand moulds. The moulds can be advantageously lined with plumbago. The metal should be poured quickly, and at very little above the melting point; otherwise the castings will be unsound. Molten aluminum flows readily, and not much larger gates are needed than with brass. The shrinkage of average aluminum castings made by the Pittsburg Reduction Company is about 0,17—64 inch to the foot, as measured by an Olsen's shrinkage testing machine, the shrinkage can be reckoned to be about 2.26 per cent. of the length of the mould ordinarily. Aluminum becomes covered by a very thin, almost imponderable, coating of oxide on its surface exposed to the atmosphere, which seems to protect it from further oxidation. This coating is so thin as to hardly in any way interfere with the surface polish which the metal takes, and does not change the weight of the metal as determined by the most delicate of chemical balances. In the chemical laboratory of the Pittsburg Testing Laboratory, we have a thin weighing scoop hammered out of an aluminum sheet, which weighed 2.2086 grammes eight years ago; it has not changed in weight one-tenth of a millogramme since. The popular general statement that aluminum is unacted upon by air, either moist or dry, or by water is practically true. According to Deville, water has no action on aluminum, either at ordinary temperatures or at the boiling point. The accuracy of this statement the authors have very frequently verified, finding aluminum wire subjected to the action of steam and heated air to retain its original polish and not to lose weight, after six hours' exposure. Aluminum containing sodium is rapidly acted upon by hot water, dissolving out the sodium and leaving the aluminum spongy and weak, fit only to be remelted, whence it comes out purer and better in quality for its freedom from the sodium. Aluminum is unacted upon by either concentrated sulphuric or nitric acids; hydrochloric acid is its natural solvent; and when either sulphuric or nitric acid is contaminated with any hydrochloric acid, even though in very small proportions they rapidly corrode aluminum; the hydrochloric acid forming chloride of aluminum which in turn is converted into sulphate of nitrate, the hydrochloric acid being again set free in a nascent state to again attack the aluminum; in this way the corroding chloride acts as a carrier for the sulphuric or nitric acid. Aluminum is unacted upon by sulphuretted hydrogen, carbonic oxide or carbonic acid gases, or by sulphurous acid or other sulphur vapors These facts add much to the value of aluminum for many purposes where the tarnishing of silver is a serious inconvenience. It is also practically unaffected by common salt, either wet or dry, or by sea water, or by weak solutions of salt in acetic acid. A piece of aluminum $3\frac{3}{8}$-inch by $1\frac{1}{2}$-inch by 7-32 inch was immersed for twenty-three days in a 3 per cent. solution of common table salt, at a temperature of 80 degrees Fahrenheit. The strip lost 0.025 gramme in weight; 4.27 square inches were exposed; this would give a loss by corrosion per square inch per week of 0.00178 gramme. A similar strip was immersed for a similar length of time, under like conditions, in a solution of 3 per cent. common salt with 2 per cent. of No. 8 acetic acid. The action in this case was not confined to that portion immersed in the liquid, but a crust of basic salts was also formed on the portion of the plate above the liquid. The strip was frequently reversed end for end, in order to equalize the action. This piece lost 0.165 gramme upon an area of 6.4 inches, and the loss was at the rate of 0.00785 gramme per square inch per week. These solutions were chosen as fairly representing extreme conditions to which aluminum would be subjected for domestic culinary operations. This corrosion is very slight, and of no practical consequence, being much less than tin plate or silver plate would suffer under similar circumstances. Solutions of the caustic alkalies readily attack aluminum. In ammonia aluminum is turned gray in color, but does not lose weight or strength. Chlorine, bromine, iodine and fluorine attack aluminum and corrode it. Aluminum is unacted upon by organic secretions, such as sweat, saliva, or the like; and the metal is finding considerable uses by dentists in the metal plates upon which to back false teeth, as well as by surgeons in traecheometer tubes, etc. For these purposes the aluminum should be free from iron, as it is found that when iron is present in the aluminum that the metal is acted upon by the saliva. The specific gravity of aluminum being taken as one, soft steel is very nearly 2.95 times as heavy, copper 3.6 times as heavy, ordinary high brass 3.45 times as heavy, nickel 3.5 times as heavy, silver 4 times as heavy, lead 4.8 times as heavy, gold 7.7 times as heavy. A sheet of aluminum twelve inches square and one inch thick weighs 14 03 pounds; a bar of aluminum one inch square and 12 inches long will weigh 1.17 pounds. A bar of aluminum one inch in dimeter and 12 inches long will weigh 0.918 pounds.

A cubic inch of	cast aluminum weighs....	0.092 lb.
"	cast aluminum weighs....	158.967 "
"	soft steel weighs..........	490.450 "
"	wrought-iron weighs......	485.874 "
"	copper weighs.............	554.988 "
"	ordinary brass weighs....	524.160 "

Aluminum has about the tensile strength of cast-iron, with only about one third of its weight, and casts equally as easily and successfully, and will, therefore, be very advantageously used to replace cast iron in the parts of moving machinery that have to be reversed or otherwise have their momentum overcome; for with one-third the weight, and consequently one-third the momentum, aluminum will work very satisfactorily.

(To be continued.)

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THESE truths are put forth by Quinn & Co., boiler makers at Portland Me.: The horse-power of a boiler is an unknown quantity. It has no legal definition or existence. It may equal the power of a ten dollar plug bought at auction, or it might equal the power of a Jay Eye See. A horse-power depends somewhat upon the size of the particular horse the boiler maker happens to own, and the price he gets for the boiler. In buying a boiler, specify size, thickness, weight, heat surface, quality, etc., etc. If cheap boilers were put on the scales, and the weights compared with first-class work, the result would surprise the purchaser of the boiler. When you want good clothes, good boots, good sermons, or anything good, you expect to pay for them accordingly. The same rule holds good in the boiler making business. Lots of people know more about boilers than the man who builds them. We are willing they should. Buy a good boiler, but don't hire a cheap man to spoil it, and then blame the boiler. When a man is blown up by a boiler explosion he should keep going, as he is of no use when he gets back. Some peculiar boilers make steam without fuel; that is, hardly any: but the same man don't always buy a second one of the same kind. Some people (try to) boil water by building a fire on top of it. We haven't succeeded in doing it: not yet. Boilers haven't any brains, but boiler cranks have brains to spare. Cast-iron is a good material for pots, stoves, kettles, etc., etc. You can't build a good boiler out of poor material. Figures may not lie, but something depends on who makes the figures. Inspect your boilers inside and outside at least once a year. See that the safety plug is all right: it should be refilled once a year. Lift the safety valve every day. An ordinary steam gauge is as fickle and changeable as the weather. Test it at least once a year.

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"THERE has been a great improvement in the condition of the sailor in the American navy since I first entered it. The Government is doing everything in its power to make things pleasant for him and to induce the young men to enter the department. When I started into service we had to live on a lot of old vessels, in which the air below decks, when the hatches had to be battened down, was something frightful. I have known times when even the heartiest would become sick after an hour or two. What with smoke and the impossibility of ventilating properly, one could almost cut the air with a knife. The fare was hard tack and salt junk. There were no delicacies then, and discipline was very strict. Now, Jack lives better than the ordinary workingman does ashore. The new vessels have electric lights instead of the oil lamps, and appliances for ventilating, so that the air in the hold is as wholesome as on deck. There is plenty of room and every possible convenience. As for the fare, the sailor has fresh meat frequently, and when that is impossible he gets canned meats that are almost as good. Further than that the department enacted a law several years ago under which the sailor could sell certain rations and receive their cash value therefor. He could either sell what he did not want to the Government at the price that the Government paid for it, or else he could sell at the ports at which the vessels stopped."—*N. Y. Sun.*

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A MAN never knows how many friends he has until he comes to need them.

TRADE NOTES.

THE steamship '*Etruria*' is being overhauled. It is decided to put a new shaft in her, and to make an effort to beat the '*City of Paris.*'

* * *

AN armor plate roll weighing 200 tons has just been shipped to the Navy Yard at Mare Island. It was built at the Niles Tool Works.

* * *

HENRY R. WORTHINGTON, New York, has issued a new catalogue of his pumping machinery for all purposes, which will be sent upon application. The work done by this firm in its line comprises every type of steam pumping machinery, also water meters, and independent condensers for marine and stationary uses.

* * *

AT the Schaghticoke, N. Y., powder mills, peas instead of charcoal enter into the composition, and the roaster in which they are prepared is capable of roasting a ton of peas every twenty-four hours. Peas thus prepared are also sent to the Newburg mills, which are making the same kind of powder.

* * *

THE Secretary of the Navy has rejected the bids of Sam Moore & Sons, of Elizabethport, N. J., for the construction of two 1,000-ton gunboats, and an 800-ton practice vessel, on the ground that they do not possess the necessary plant for the work and cannot provide it within the required limit. It is now for the Secretary to determine whether he will accept any of the remaining bids or re-advertise for others.

* * *

LUTHER H. LEBER lately made his first experiment of photographing the bottom of an oil well. The instrument was let down 1,700 feet. The moment it touched bottom a bright flash lit up the cavity, and a perfect picture of the hole was impressed on the negative. It revealed, as the effect of the explosive shock, a cavity fourteen feet broad and seven feet below sand. Pebbles and minute objects were distinctly revealed upon the plate.—*Oil, Paint and Drug Reporter.*

* * *

THE '*Vesuvius,*' U. S. N., will be required to undergo a new test of speed and of armament officiency. The department desires to know the actual amount of horse-power developed. No one doubts that the cruiser developed an excess of the contract stipulation, which was 3,000 horse-power. It was estimated that in her speed run made in January, 1889, over 4,200 horse-power was developed, but inasmuch as no actual record was kept, another speed test will have to be made.

* * *

IF the savings of people in savings institutions are any index as to the prosperity of the city, then the past year has been a fairly good one for New York. But four of New York City's banks show greater amounts withdrawn than were deposited. The excess of deposits over withdrawals amounts to over $6,500,000, while the withdrawal in excess of the deposits foot up about $1,700,000, the bulk of this being in the Seamen's. This leaves a net gain in deposits of nearly, if not quite, $5,000,000.

* * *

THE British Government, it is said, has fully determined to adopt the dynamite gun as an auxiliary to the coast defenses, provided the coming tests at Shoeburyness prove as satisfactory as those made last year at Fort Lafayette. It is further learned that England proposes to erect similar batteries in India, Australia and the West Indies. The anticipated order for fifty guns, it is believed, is only a commencement, and it is expected that before the year is over another order, as large, if not larger, will be given for the same weapon.

* * *

THE veteran locomotive Samson is waiting for a purchaser anxious to obtain a relic of the early days of railroading. It was built by Timothy Hackworth of Newcastle, Eng., and weighs less than twenty tons. Its original cost was $8,500. The cylinders are 15 inches in diameter, with a stroke of 16 inches, and stand vertically over the hind driving wheels. The wheels are 4 feet in diameter and are six in number. They are made in two pieces, the tire being kept in position round the hub by twelve wooden keys. The boiler carried a pressure of sixty pounds of steam. As constructed, the tender is in front, and the driver sits in an iron chair behind his engine.

* * *

THE Pond Machine Tool Co., Plainfield, N. J., through its selling agents, Manning, Maxwell & Moore, 113 Liberty Street, New York, has received an order from the Ordnance Department of the United States Government for ten large lathes for the work of turning, boring and finishing guns of 8 to 12 inches caliber. The contract amounts to $247,800 The time of delivery extends over a period of about three years, which enables the Pond Machine Tool Co. to take care of its regular work promptly, and does not materially reduce the production of its shops for regular railroad and machine shop trade.

* * *

THE Massachusetts Charitable and Mechanic Association, of Boston, Mass., are to hold their triennial fair this year, opening in September. The exhibition of 1887 was a great success, but the management are aiming to surpass it this year. Now is the time for mechanics, manufacturers, artisans, artists, inventors, men of ideas, every one who has made or can make something to prepare for this exhibition. The months intervening between this time and September can be employed well in making up a collection of specimens of industry, skill, and art. There is no doubt but that this will be a good opportunity to display manufactures of all kinds.

* * *

IN the lumber regions of Northern Pennsylvania a curious expedient has been resorted to for the purpose of getting the logs out of the woods. Hundreds of barrels of crude oil have been sent to the camps and poured over the "slides." This was intended to take the place of snow. Logs can only be got to the market over slippery paths, so when there was no snow or ice they greased the mountain slides, but in spite of that the vast lumber interests of the State have suffered to a serious extent from this mild winter. This is the first time that crude petroleum has been used to lubricate slides to any extent. Some of them are twelve miles long. The momentum the logs gather with distance sends them along at a furious rate of speed. The crude oil has been found to wear for nearly a week.

* * *

THE ordnance officers in the War Department, in making their calculations for the sixteen-inch guns to be built for coast defense fortifications, hope to overcome the defects developed in such guns built abroad. In most of the guns of this caliber thus far built, cracks have appeared between the jackets and hoops after the first few rounds have been fired. This is believed to be the result of errors in calculating the force of the explosion, and the elastic limits of the metal. It is thought that the hoops have been stretched beyond their elastic limit by the explosion of the charge, and that the cracks are the result of the metal not returning to its original shape. It is believed that the guns to be built here have been so planned that the force of the explosion will be distributed evenly throughout all the jackets and hoops of the gun, without unduly straining any of them.

* * *

WITHIN five years there has been a noticeable increase in the number of merchant steamers of all nations fitted with water ballast tanks, and these tanks have even been fitted, it is understood, to warships intended for transportation work. Merchant seamen say that in filling the tanks great care must be taken to see that they are quite full. The advantage of water ballast tanks is that when moving a ship from one port to another in ballast the expense of buying, loading, and discharging ordinary ballast is saved. There is a saving in time, too. Moreover, by opening the water-ballast cocks the water is allowed to run in as the ship goes along, and as she is approaching her port she begins to discharge it through her donkey ballast pump. The only apparent disadvantage in water ballast tanks is noticed when the ship is loaded, for then, her tanks being empty, her cargo is too high, which necessarily, in seaman's parlance, makes her "crank."

* * *

A CASE of very great interest to all merchants was decided in the United States Court, Cincinnati, Feb. 20. It was the case of the United States against Sheen & Simpkinson. The action was brought under the law passed by Congress Sept. 26, 1888. The statute provides that nothing shall be put upon the outside of a wrapper, envelope, or postal card that is of a libelous, defamatory, or threatening nature, or "obviously calculated to injure" the party addressed, even by the term or manner of address.

Sheen & Simpkinson held a claim of $773.17 against E. H. Fox, a photographer of Danville, Ky. The firm testified they had repeatedly written to Fox without eliciting a reply. They then sued and got a judgment. Failing to realize on it, they advertised the claim for sale in several Kentucky papers, but the Danville papers refused to print it. Finlaly they printed on the back of postal cards an advertisement asking for bids on the claim, and addressed them to merchants in Danville.

Then Fox brought suit. Defendants proved that they had done the same thing in other cases, and, besides, while the act was passed in September, 1888, it had not been published when the offense was committed in May, 1889.

Judge Sage was severe on the defendants in his charge, laying stress on the point that not what the firm intended, but what the obvious result was, should determine the guilt or innocence of the party.

The jury returned a verdict of not guilty, the plea of ignorance of the law, owing to its non-publication, saving the defendants.

BOOK NOTICE.

A HANDBOOK OF ENGINE AND BOILER TRIALS, AND OF THE INDICATOR AND PRONY BRAKE. FOR ENGINEERS AND TECHNICAL SCHOOLS. BY R. H. THURSTON, M.A., LL D., DR. ENG'G. FULLY ILLUSTRATED. 8VO. CLOTH, $5.00. NEW YORK: JOHN WILEY & SONS.

This work consists of a treatise upon the latest methods of testing engines and boilers, and of securing and working up the data so obtained. It includes accounts of recent and, until now, unpublished methods and apparatus for accessory determinations, and very complete descriptions of the indicator and the brake, of the forms customarily used in such work. The standard method of testing steam boilers, as reported to the American Society of Mechanical Engineers, is given in full, and every detail of its application indicated, including the methods of determining the character of the steam made, and the composition of the gases from the furnace.

A full account is given of familiar forms of steam engine indicator and their attachments, as well as the methods of securing exact cards, computing power from them, and interpreting their indications. The method of estimating the amount of water and steam demanded by the engine, from the diagrams, is also shown. Complete descriptions are given of the "Prony Brake," and of other forms of dynamometer used in determination of power usefully applied; and the best methods of attachment and use are given in considerable detail. The process of designing a brake is exhibited and illustrated. Full accounts are given of the various kinds of timing apparatus, for determining the exact speed of the engine, including some novel and extraordinarily exact instruments, as the timing fork, and the physicist's and engineer's chronographs. Much of this is wholly new, and has never before appeared in any book ordinarily accessible to engineers. The appendix contains a valuable set of steam tables, logarithms, common and hyperbolic, evaporation factors, compositions of fuels, and other useful information. The book, as a whole, is indispensable to every engineer or student in any branch of professional work in which the use of steam is accessory. Mailed on receipt of price.

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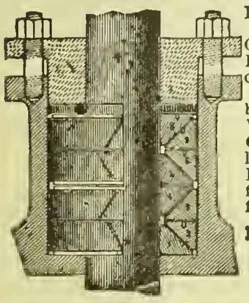

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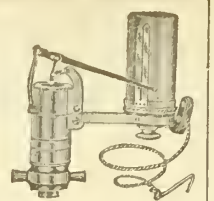

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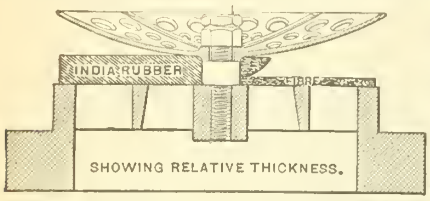

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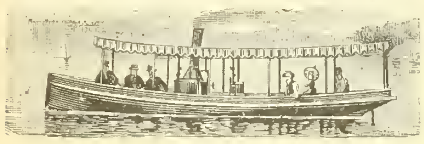

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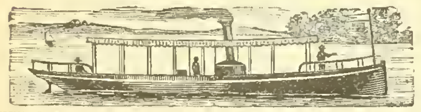

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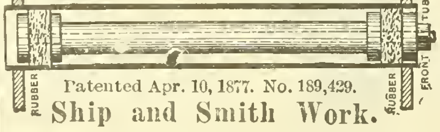

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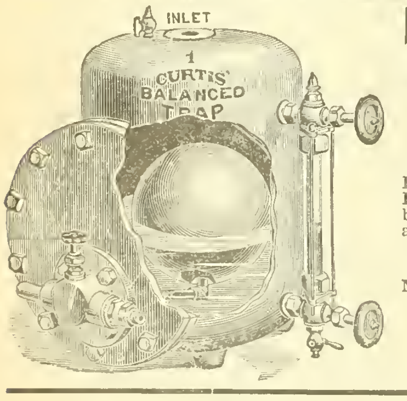

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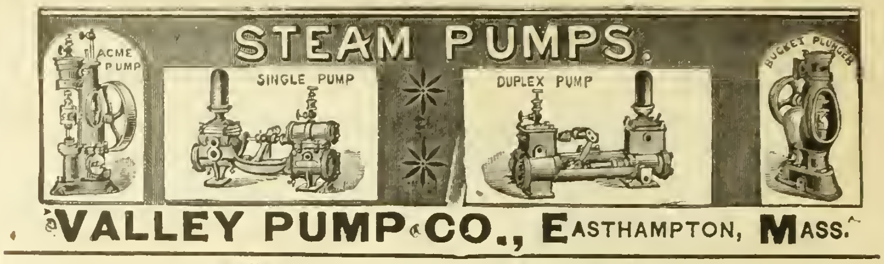

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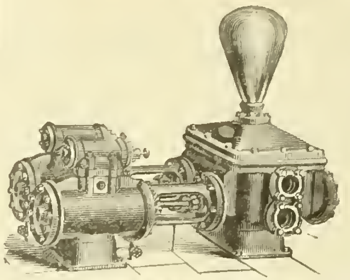

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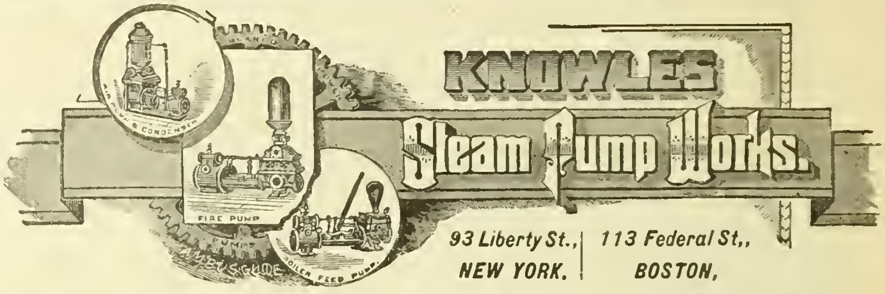

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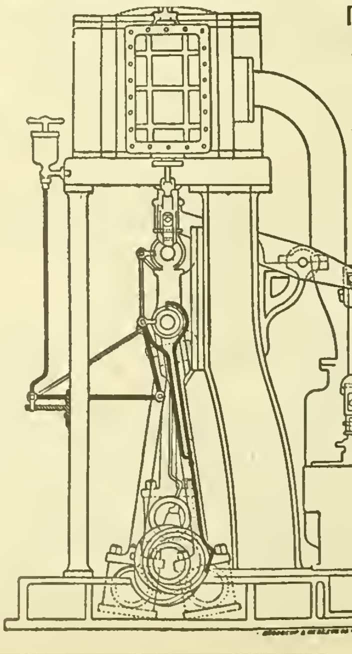

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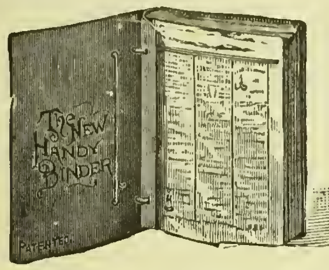

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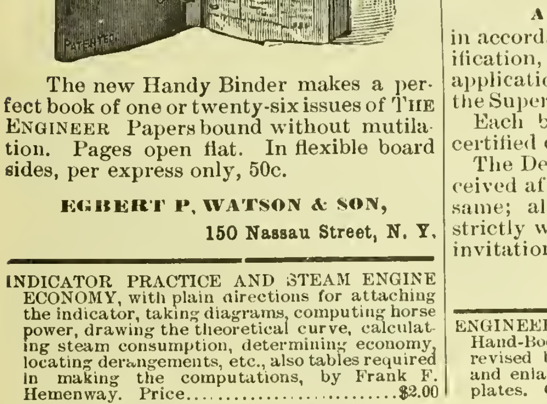
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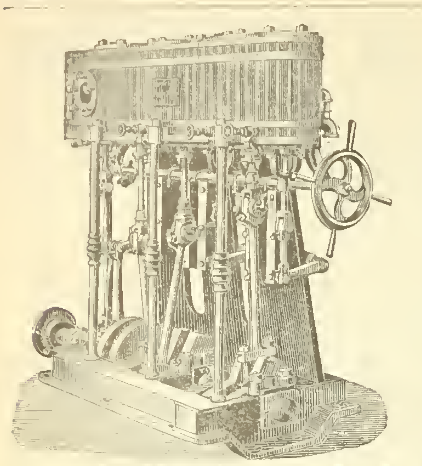

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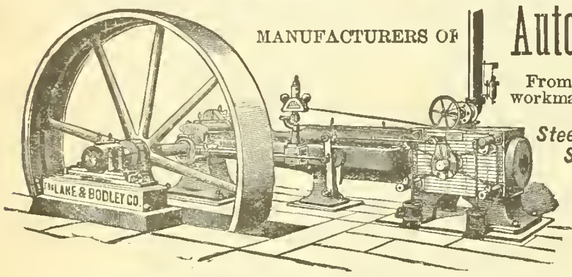

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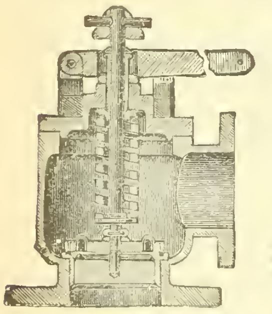

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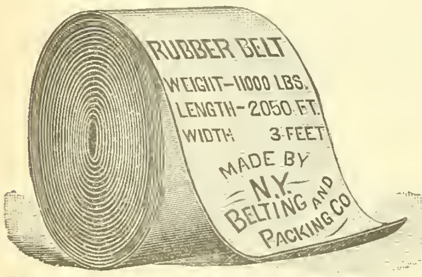

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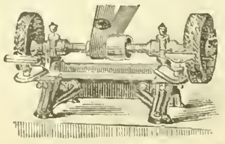

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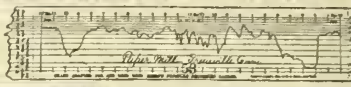

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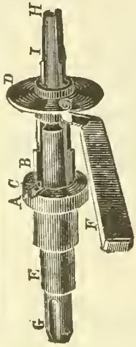

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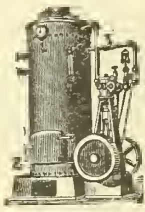

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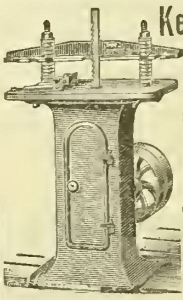

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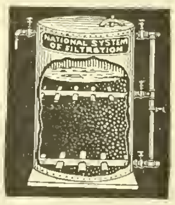

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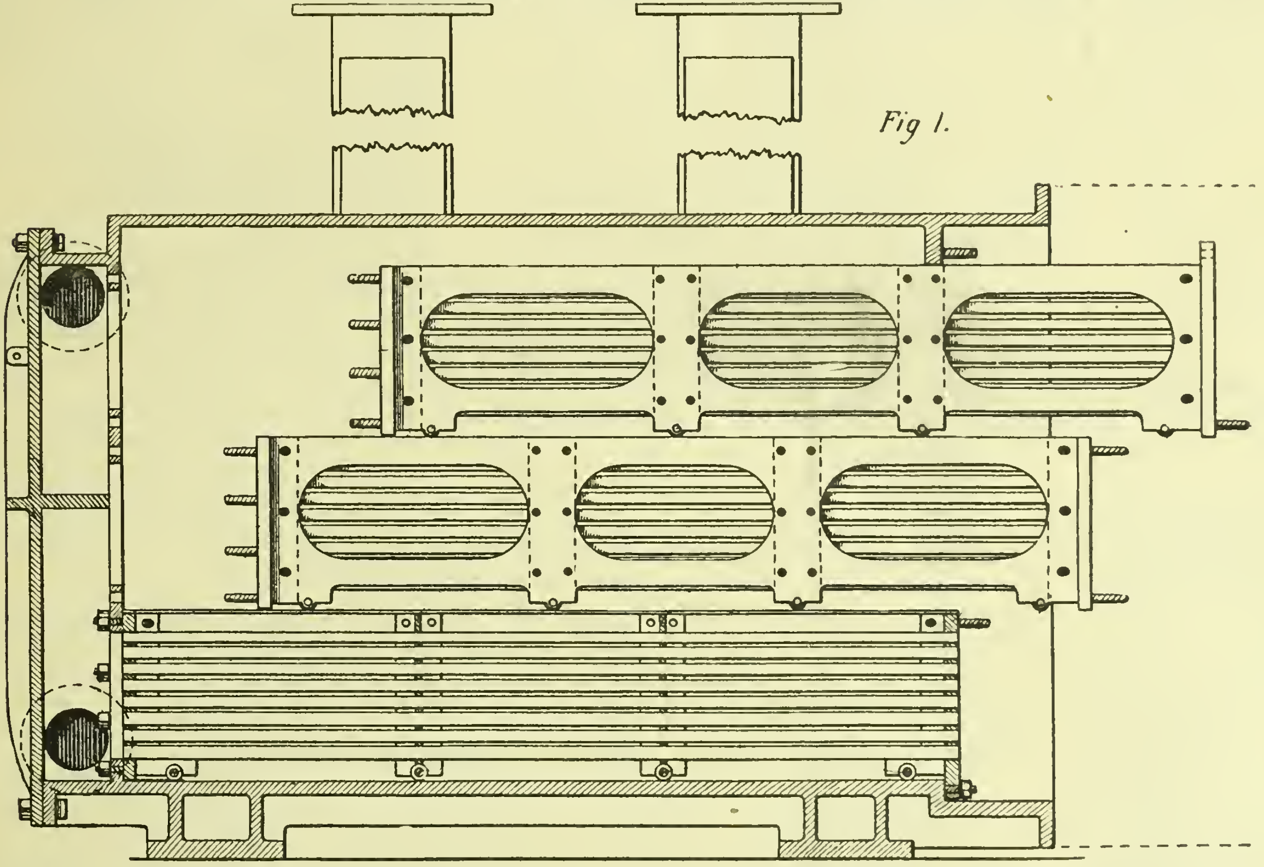
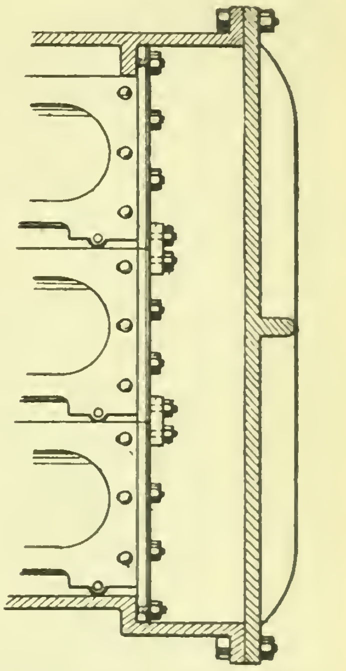


Fig. 2



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One of the contractors of the Forth Bridge, William Arrol, is a practical man, and speaking recently to some friends who presented him with a mark of esteem, he said: "Whatever I went to I put my whole mind to. Sometimes I was sent to clean flues instead of repairing the boilers, but I never shirked the duty." It is in this that lies one of the chief causes of his success, he never shirked his duty.

The modern British battleship carries an enormous amount of top hamper in the shape of deck houses, wind trunks, chimneys, boats, etc. It must not be supposed that these things could be cleared away when the ship was going into action. They would no doubt be cleared away after she was in action by the enemy's guns, but with what result? If the boiler rooms are absolutely dependent on wind trunks for air, and these trunks are smashed up and disorganized, how is steam to be kept? Such ships as the '*Victoria*' when steaming are drowned forward, just as a monitor would be in a sea. If we contrast the mark which such a vessel as the '*Victoria*' presents with a monitor carrying two heavy guns in two turrets, it is obvious that all is in favor of the monitor. That, at all events, is the way in which they are arguing in the United States, and we find it difficult to resist the conclusion that we might do worse in this country than reconsider the monitor question in the light of recent developments in steam, armor and guns. The lamentable loss of the '*Captain*' killed the system in this country. But no one nowadays would dream of masting a monitor. We shall look with some interest to the course to be taken in the United States, and we shall be much surprised if the last has been heard of the low freeboard turret ship.—*London Engineer*.

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The Sailors and Firemen's Union of New York talk of building a sailors' boarding-house. They want $35 a month for sailors on steamships; on sailing vessels, $30; oilers on steam vessels, $50; firemen, $45; coal passers, $35.

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By a special request of the deceased member of our firm the style of it is unchanged, and will remain Egbert P. Watson & Son as before.

Every seafaring man knows that the "suction" of a fast vessel extends to a considerable distance from her when under way, so that if a much slower boat than she is can get near her, the slower boat keeps along with the faster one. On this subject the following extract from Mr. P. G. Hamerton's yachting tour on the Saone is interesting. The small sailing yacht or "catamaran" '*Arar*', is a double hull boat. Returning against the stream in the wake of a huge barge towed by a small steam tug, Mr. Hamerton says: "On drawing the '*Arar*' close to the barge, I found the motion less fatiguing, but the curious thing was this—the '*Arar*' now followed without a hawser. There was, in fact, no necessity for a rope. as our boat was propelled by the back-water behind the barge. The '*Arar*' kept the noses of her two hulls at a distance of about three inches from the stern of the boat before her, and that with marvelous steadiness. For some time the two hawsers hung idly in festoons, but they were entirely detached before we came to the bridge at Macon; yet the '*Arar*' followed under the arch against the general current of the river, though, in reality, on the rapid counter-current of the back-water. How can a steamer tow a small boat without either increase of power or diminution of speed? The question appears insoluble, yet here is a solution of it—the steamer's motion may create a back-water behind a flat-sterned barge that she is towing, and the small boat may follow on the back-water without imposing the slightest extra tax upon the tug."

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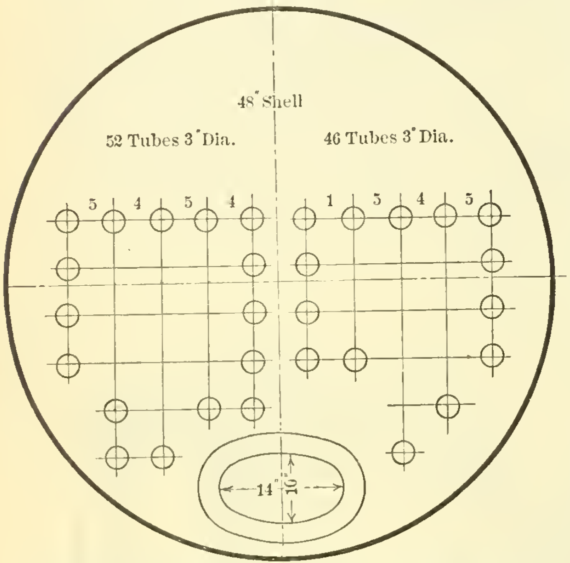
As Dixon's "American Graphite" pencils are somewhat less in price, are American-made, and are, to say the least, the equal of the finest imported, should they not find a place in every draughting-room in America in preference to imported goods?

BOILER MAKING. No. 35.

By John Cook.

A great deal might be said in regard to boiler making as it is now carried on. Steam users use higher pressures now than they did some years ago, but I don't see much change, except for the worse, in the construction of the boilers. We will take, for instance, the locomotive type of boiler. The pressure on these will be from 100 to 150 lbs., sometimes more. The stay-bolts will be from 5½″ to 6½″ apart, according to where the foreman learned his trade. Such boilers, after being used for a year or less will show bulges between the stay-bolts, both on the sides and crown of fire-box. If the boiler-maker is asked why this is so, he will say, like enough, that it was caused by too much pressure; by mud, if on the sides, or it was burnt if on the crown. You can't make him believe it is caused by stay-bolts being spaced too far apart. Oh no! he has been a good many years at boiler making, and he don't put them any farther apart than others put them. If asked if they have any rule to get the centers of stay-bolts by, his answer will be, "Yes, experience." His experience is to have them not less than five and a half or more than six and a half inches; that is his rule. No matter if the boiler has to carry fifty or one hundred and fifty pounds, the stay-bolts will be set the same distance apart.



It is very seldom that we see stay-bolts 4″, 4½″, or even 5″ apart in any shops, unless they have been especially ordered so, and then there will be some comments about the man's sanity in having them so close. If any of these gentry are shown a rule to get the distance of stay-bolts for any pressure wanted, and it comes closer than they guess, they will laugh at the person who shows them, and tell him they don't have to go to books to get what they want; or they may say that they have books but never use them. I don't wonder, for it would be Greek to them. What a benefit it would be to boiler makers if somebody would get up a book with all the rules in plain arithmetic, and explain how to work them: or, better still, have tables of distances for stay-bolts, rivets, braces, etc., for all pressures, sizes, and shapes of boilers, and have a law passed to have them adhered to. As it is now, I am sorry to say, there are a great many foremen boiler makers who do all their work by guess, or as they have seen it done by others no better than they are. As for books, (excepting tables of diameters and circumferences), they know nothing about them. If they have a book, you will see that part of it pretty well thumbed.

I don't take much stock in hand-holes in the back heads of stationary boilers. They are always leaking; the bolt and guard, or bridge, are always burning off, and they get scarcely any supervision. A boiler from 44″ up, can have a man-hole at the front end under the tubes without losing any heating surface or rating, it is much easier to clean and repair and leaves a good body of water over the fire.

I believe in having the tubes arranged in perpendicular lines, and fully one inch space between each tube; if possible 1½ or 2″ between every other row, same as in diagram. This gives better circulation. Some makers leave a space in the center of the boiler of 3″ to 4″. I have an opinion that it weakens that place by not being braced. By having the spaces between every other row, besides giving more circulation, it is easier to clean the tubes of scale by scraping, and gives better opportunity to wash out.

(*To be continued.*)

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SQUARE THREAD SCREW TOOLS.

In the last issue a diagram for rake of a tool for cutting square threads was given which was not correct. A correspondent of the *Mechanical World*, Manchester, writes as follows to that journal:

"The correct method is to draw a vertical line equal in length to one and a half times the diameter of the screw to be cut, and then draw a line at right angles to this line equal in length to half the pitch, then the hypothenuse gives the angle or rake of the tool to cut the screw. Fig. 1 represents a portion of the screw to be cut—viz., 2 in. diameter, 2 in. pitch, with four threads, the width of tool is ¼. Fig. 2 represents the two methods. A^1 is the rule given in the article, and B^1 is my rule. In Fig. 3 the thick line A^2 represents a section of the thread, as also does the thick line of B^2. The dotted lines in A^2 represent the shape of tool found by the wrong method, and the dotted line B^2 is the shape of tool by the right method. *C* is the form to which the tool A^2 would have to be filed, and *D* is the form the tool B^2 would be. It is evident that if the tool is made to A^1, and then laid on the sketch, it would fit the thread exactly; but it must be remembered that a drawing of a screw and a screw in the lath are two different things. The thread in a common sketch like the one given, is represented by a straight line, but the line in the screw or in a correct drawing is a curve, so that a tool made according to rule A^1 would have to be filed, as before mentioned. Therefore, the top of the tool would not be at right angles to the side of the thread to be cut, and there would be too much lead, or rake, on the left-hand side, and not enough on the right-hand side. On the other hand, if a tool is made as in B^1, the angle obtained would correspond to the true curve of the screw, so that it would be a perfectly square tool, fitting the space of the thread, and not liable to dig in while cutting. This theory may be tested by making a toolholder (fig. 4), which is about 8 in. long and 1¼ in. square. Face up the ends, and drill a quarter-inch hole about 4 in. long; then drift it with a square drift, holding the screw-cutting gauge, set to the proper angle, on the anvil. Forge a little boss for a set screw, and drill a hole through the remainder of the length of the toolholder, to admit a long piece of steel, say, one-quarter inch square, for the present purpose. A tool so made can be left square and put in its place. Cut off a piece of one-quarter inch square steel, say 8 in. long, file or grind a little lead on the end, harden and temper it, put it in the toolholder, and it will be found to come exactly right. If this is not quite clear, an experiment with the two methods will soon show the difference, and the time spent in so doing will be amply repaid.—*R. B. Hodgson.*

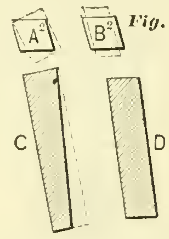

Fig. 3

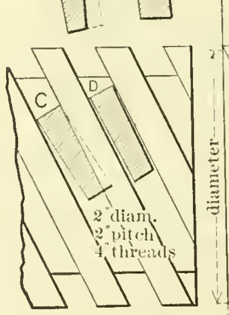

Fig. 1

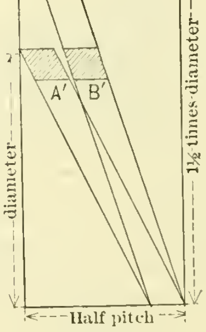

Fig. 2

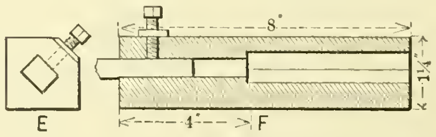

Fig. 4

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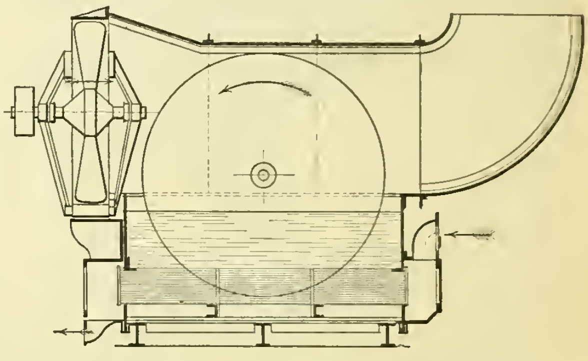
A NEW CONDENSER.

The illustration shows a novel form of condenser which has been used with considerable success in Germany and other parts of the Continent. The exhaust steam from the engine enters at the right, and passes through a series of brass pipes immersed in water, to which it gives up its heat. Between each section of tubes a number of galvanized disks are caused to rotate. These disks are cooled by a current of air supplied by the fan shown at the left, and pass down into the water, cooling it by abstracting the heat given out by the exhaust steam and carrying it up where it is driven off by the air current. The disks serve also to agitate the water and thus aid it in abstracting the heat from the steam. With 85 per cent. vacuum the temperature of the cooling water was about 130° F., and a consumption of water for condensing is guaranteed to be less than a pound for each pound of steam condensed. For an engine 40 in. × 50 in., 70 revolutions per minute, 90 lbs. pressure, there is about 1,150 sq. ft. of condensing surface. Another condenser, 1,600 sq. ft. of condensing surface, is used for three engines 32 in. × 48 in., 27 in. × 40 in., and 30 in. × 40 in. respectively. —*The Steamship.*



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In the electric lighting field of Boston and some other cities, the fire underwriters will not insure a building which has been wired by other than those whom they have examined and given a certificate of efficiency. Following out the same idea, boiler insurers ought to know the men in charge of the boilers they insure; ought, indeed, to have a record of their careers; the way boilers fare under their charge. For mere examination, as said before, goes for but little. Is the man careless or attentive, slovenly in appearance and action, or neat and active? Every man has his equation of error in judgment, as well as in sight and hearing. If this could be ascertained in the case of engineers and a record of the same be kept, there is reason to believe it would prove of inestimable value, not only to boiler insurers, but as well to steam-users.—*The Safety Valve.*

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Thieves in the Custom House stole wine belonging to a prominent man, and on complaint being made to the collector, he said he could not help it. Bad men were foisted on him and the civil service rules hampered him. He adds:

> "I have the same difficulty, it may be added, in regard to engineers, who also must pass a civil service examination, while it is apparent, especially to a railroad man, that many a train would be ditched if the engineer who pulled the lever was placed there by reason of a civil service examination on general culture."

CORROSION OF PROPELLER SHAFTS.

AN interesting example of the havoc which sometimes results from the commonly employed system of lubricating propeller shaft bearings by admitting sea water to the stern tube has recently come under notice. Messrs. Morton, of Leith, on removing the brass liner from the propeller shaft of the '*Lofna*,' were surprised to find the shaft underneath the liner corroded and cut in to the depth of ¾ in. On breaking the shaft at this corroded part it was found that the sectional area remaining intact was only 43.57 per cent. of the original area, or very considerably less than one-half. How the shaft should have continued running in this highly precarious state is truly astonishing, but the cause of its having got into such a state at all is no less curious and significant. This was due to the liner having been shrunk on in two pieces, the joint of which, although so closely fitted as to render it barely perceptible, yet permitted the admission of sea water to the bare shaft, with the result noted. This case doubtless illustrates the danger of fitting brass liners in two lengths, but it may also be considered as raising the point whether the frequency of breakdowns of shafting at sea may not often be due to the presence of brass liners—whether in one or more pieces—in conjunction with the admission of sea water to the stern tube. Brass liners are fitted less for the purpose of protecting the shaft from corrosion than on account of their wearing better when running on lignum vitæ and admitting of wear without weakening the shaft thereby, but there seems little room for doubt that the bare shaft at the point, say, when the brass liner begins and ends, is particularly liable to corrosive influence. It remains, therefore, a point for serious consideration whether some system of lubrication should not be employed which would obviate the use of expensive brass liners altogether, and exclude from the bearing such a dangerously corrosive element as sea water.—*London Engineer*.

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AN OLD INDENTURE.

THIS is the form of indenture that apprentices had to live up to in days gone by. How many would do it now?

"This indenture, made this 21st day of August in the year of our Lord, 1809, between —— of the town of ——, county of ——, and State of New York, and his son ——, of the one part, and —— of the same place of the other part, witnesseth, that the said ——, by and with the consent of his son, ——, doth by indenture bind him, the said ——, unto the said ——, for and during the term of thirteen years from the 10th day of January next, and that the said —— shall behave himself during the said term as a good, faithful and true servant ought to do. And it is further agreed between the said parties that the said —— shall keep and maintain said —— in victuals and wearing apparel, and provide sufficient physicians in case of sickness, and this at his own risk, for the term above mentioned. And that he, the said ——, shall learn him, the said ——, the trade of a tanner and currier, and that he shall school him, the said ——, in reading, writing and arithmetic suitable to carrying on his business, and that he will not in the least abuse or misuse him. And that he, the said ——, will, at the expiration of the said term, furnish him, the said ——, with one new suit of every-day clothes and one new suit of holiday clothes, together with all his former clothing, and that when said term is expired he will discharge him from his service."

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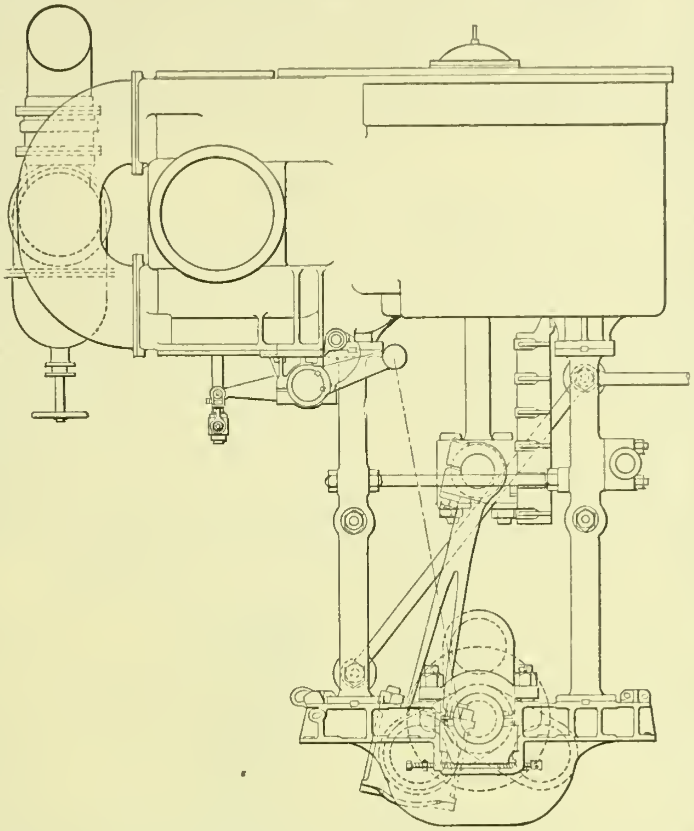
A SCOTCH captain has so far braved tradition as to invent swing scupper doors, or side plates, as he calls them, for vessels. Just why a vessel should groan and labor for ten to fifteen minutes, while an overwash is finding its way out of the usual scuppers, has always been a puzzle to "land lubbers." Even old farmers, who are not usually accounted as belonging to the "genius" class, know enough to hang a flood gate for the passage of water one way and to stop it the other way. This is what Captain Fairlee, the inventor, has done—hinged scupper plates so they will open outward and shut inward.—*Industry*.

ENGINES OF THE 'MAINE,' U. S. N., TWIN-SCREW CRUISER.

THE engraving shows an end elevation of the engines of the '*Maine*,' and indicates the type and general design. There are two sets of these in water-tight compartments, divided by a longitudinal bulkhead. The cylinders are 35½″, 57″ and 88″, by 36″ stroke, and are intended to develop 9,000 h.p. at 130 revolutions per minute. All the details are interchangeable. The piston valves are all of the same size, 22″ diam., and there is one on the high-pressure cylinder, two on the intermediate, and three on the low-pressure cylinder. Link motion is used, and the cylinders are steam jacketed. The shafts are hollow, of forged steel, and are 13″ diameter.



The condensers are of the usual type, and have 7.010 square feet of surface. The boilers are 14′ 8″ diam., single ended, to work at 135 pounds per square inch. Each boiler has three corrugated furnaces, 42″ diam., and 519 steel tubes, 2¼ inches diam., 6′ 7″ long. The total grate surface is 553 square feet, and heating surface 18,800 square feet. Forced draught, on the closed ash pit system is used. A special feature of these engines is the provision made for throwing out the low-pressure cylinder when cruising at low speeds, so that they can be used as a two-cylinder compound. A special exhaust pipe leading from the intermediate cylinder to the condenser, for the purpose indicated. These engines are building at the Quintard Iron Works in this city, and are said to be of excellent workmanship.

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THIS awful thing is from the *New York Sun*, and pretends to describe a new propeller: "The peculiarity of the new method of propulsion lies in the placing of the wheels amidships and allowing one blade of a four-bladed paddle wheel to protrude slighty below the hull. The remainder of the wheels run in tight drums or cylinders lying within the boat, one on each side of the keel. The boat is 30 feet in length by 6 feet beam, and the engines are rated at 7½ horse-power and capable of developing 300 or more revolutions per minute. The paddle wheels are 18 inches in diameter, and being connected directly to the piston rods of the engines, they revolve at the full rate of the engines' speed."

"The remainder of the wheels!"

"Connected to the piston rods!"

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FEW people realize how the consumption of sugar has increased in this country the past few years. It now amounts to fifty-eight pounds per capita per year, which is an increase of about thirty pounds for each individual within twelve years.

LONG SCREW NUTS.

SOME years ago, there was constructed at Pittsburg, Pa., a testing machine in which the force was applied by a screw. The designer of the machine used a very long nut so as to secure a large amount of bearing surface, just as nine out of ten persons would do in a similar case. It was found, in operating the machine, that as soon as the screw was subjected to heavy strain it became "jammed" in the nut, and the result was directly the opposite of what was aimed at. The matter was referred to Mr. Robert Briggs, of Philadelphia, an engineer of extensive practice, who at once explained the matter as follows:

In the case of a screw and nut, the strains tend to stretch the screw and compress the nut; the pitch of one being lengthened and pitch of the other being shortened; the longer the nut the greater this difficulty.

No doubt a good many who read this will know of the tendency of screws to jam when the nut or bearing is long, even in the case of set screws in thick bearings, there is difficulty in setting them down hard. Under light strain, and where the main object is to avoid wear, long nuts are desirable, but will not do for presses, testing machines, or in any case where the strain is enough to cause elongation of the screw or compression of the nut.

It is common to fit screws, especially those with square threads, with not more than $\frac{1}{100}$ of an inch of play for each inch of diameter, and it is easy to conceive how this play would be taken up by elongation, even under a moderate strain.

Screw nuts made with taps are seldom of a true pitch, because taps are usually contracted by hardening, and thus become too short in their pitch. In some cases taps are cut with an allowance for shrinkage in hardening, and this is not a difficult matter, if provision is made for causing a movement of a lathe screw nut equal to the shrinkage, and then cutting the taps accordingly. We saw many years ago such a contrivance on lathes at the works of Mr. Whitney, in Winchendon, Mass.; also, at the same works, a "master screw" 40 feet long, made by Whitworth, which cost more than $400—an implement found only in a few of the largest works of the country. In the same works are engine lathes arranged to cut taps of "long pitch," and many other special tools.—*Industry, San Francisco*.

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EXPLOSIVE DUST.

THIS is from the *American Miller:*

"An old miller, relating some of his experiences in the mill, tells the following instructive incident: 'When I was a lad I was sent to hold the lamp for a millwright who was doing some repairs up among the joists in the garret. I went up the ladder close behind him carrying the naked lamp in my hand. On arriving at the top he knocked some fine dust off a cross-piece with his foot, which fell with a shower on the lamp, and the flame flew up in my face, completely singeing me, and spread like a flash along the length and breadth of the garret. When I recovered and looked around, everything was blackened which but one minute before was hanging with dust and cobwebs.'"

We can supplement this from our own knowledge. Joseph Canning, a young mechanical engineer of fine promise, was killed in a Lowell machine shop a few years ago by the same cause. One night he was doing something to a belt and had occasion to use a lantern. This he deposited on a beam. The lantern was knocked over in the dust which immediately exploded like gunpowder, killing Mr. Canning instantly. Any finely pulverized substance, flour dust, starch dust, (a candy factory was blown up in this city some years ago by starch dust) is liable to violent explosion from its rapid absorption of oxygen where a naked light is exhibited.

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SOME women work in Russia from four o'clock in the morning till sunset for eighteen cents.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

"IT IS DAMNED HOT!"

Editors ENGINEER :

Henry Ward Beecher once shocked his congregation with this ejaculation, and during the silent interval he ran his fingers through his hair, then said: "Such, my beloved hearers, was a remark which met my ear as I entered this vestibule; it came from the lips of a promising son in my church."

The sermon which followed, was brim full of mental food, but no more so than the text on page 44 of your issue of February 15, which is "*Beating the Record.*" Many of your readers beside your humble servant, "who have been there and taken all the degrees," wish that that article could have half the chance before the reading public that the average blood and thunder novel gets. There would be an extra line in the "whereases" and "resolves" of the grateful passengers in recognition of the real men who had their lives in keeping through the perilous voyage.

To the ambitious young man in the shop, thirsting for steamship honors, that text means a great deal, if they only think it over; say, for instance, when they are doing work on any part of an engine to be subjected to just such treatment.

Vividly do I remember a misfit key on a job at the "Morgan Works" in 1861, when it caught the eye of that vigilant old Spartan "Black" Jack Gallagher, and never shall I forget his impressive lecture! "Young one," said he, "do all your work as if you were going to sea with it yourself! A fit like that might be the key to Davy Jones' locker for some poor devil of an engineer, and all his ship's company. Then he made me figure the total pressure on the piston—the blow that "loose key" would get twice in a revolution—and left it to me if I would like to go out in her. Old Jack was a staunch friend to the boys along the Dry Dock, always turning a sharp reprimand into a useful practical lesson, and his memory is cherished by those who knew and yet snrvive him. Here is a "prophecy" of his already fulfilled (perhaps you were with us on the same trial trip) when he showed us how to detect steam-leak in piston or valves by sonnd, through a piece of wire, one end held by the teeth, the other resting against the side pipe or cylinder, and plugging our ears with our fingers. It was truly wonderful to us. Mr. Jack said, "that's a great thing, young ones! Some fellow with a head on him will make it beat the indicator."

It is a singular coincidence that I should meet that very man old Jack spoke of here in Salem twelve years afterwards—it was in the Old Corner Bookstore. Noticing his quiet manner I asked about him and was told in a facetious tone, that it was Mr. Bell, Alexander Bell (of telephone fame) the man with the talking wire; he's got a hobby and no money to develop it, and in spite of the gibes of scientific and moneyed friends who doubted his sanity, he quietly persevered, aided by a fresh young mind from the Salem schools, until he solved the problem and gave the first public exhibition in the historic Salem Lyceum before a distinguished audience, including able men who had not before encouraged him.

What a lesson he taught them!

This leads up to the conviction, in my mind, that it is not generous or in good taste to condemn a case unheard. Take for example your old friend Ericsson; when—aided by his club associates—his first propeller was launched on the Thames, English iron masters, editors, and others connected with maritime matters, said it was a "blarsted windmill under water, don't-ye-know, and wouldn't be a safe thing to cross the channel with." Yet they are now putting two of them into each ship, to keep ahead of our merchant marine, and beat the record with.

Now I don't want to see the editor of THE ENGINEER execnte a travesty on those "London fellows" who consider their depositions unanswerable! but the pronunciamento "*She Will Not Evolute,*" page 148, in late number, looks that way, and might be a cold water bath to a less brainy man than the projector of the *Evolution* is known to be!

If I jump too hard on to that article, it is because I am solicitous for the good influence of THE ENGINEER with the many young mechanics who read it, and are too apt to guess it won't wash, or the old man would say more about it.

Why not say enough to set them thinking about the philosophical principle embodied in the proposed sneeess of hydraulic propulsion? At any rate, it might lead some of the earnest ones to discover for themselves a difference in force applied, dynamic and static.

Chief Engineer Theodore Zeller, U. S. N., took ont an atom of my enormous conceit with the startling question of:

"How do yon know?" "You say it is, Why is it?" I was before an examining board, trying to show him how to work out the safety valve, and wasn't sure why .7854 was the decimal, or what it represented. He gave me until next day to find out. It was simple, and I should have learned it at school; I'll warrant you have lots of readers in the same boat now.

All about here there are favorable comments on your endeavor in presenting portraits and outline work of our famous American engineers, young and old, and hope it will continue as a feature in the volumes to come. There is plenty of material, and when compiled will make a book in continual demand and of inestimable value to mechanical readers of the present, and those who come after.

It will be a unanimous vote—and strictly in order—that the editor of THE ENGINEER produce the first volume of this at his earliest convenience.

J. G. DENNETT.

Salem, Mass.

[Friend Dennett has our thanks for his communication, and to take the last part of it first we say that American engincers have no superiors in constructing or operating, and we are going to make a record of them, past and present, as far as we can. The limits of space do not always admit of detailed treatment of new vessels or new principles applied to them, that is to alleged new principles. There is nothing so far announced in the vessel alluded to warrant the expectations of the inventor, who, however brainy he may be, is still human and liable to err.—EDS.]

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SHODDY BOILERS.

Editors ENGINEER :

I am a subscriber to several engineering papers, first among which is THE ENGINEER. I read with great interest the articles by John Cook and others on boiler making.

Despite all that has been written npon defective construction and explosions arising from this cause, boiler makers continue to turn out snch magazines as the following, and sell them to people who don't know any better than to buy them.

I read an account not long ago of a boiler explosion, the cause of which was found to be "defective bracing."

This boiler was 34 in. diameter × 16 ft. long. Shell of $\frac{9}{32}$ steel, heads $\frac{7}{16}$ steel, with 40 4-in. tubes and 667 sq. in. of head depending upon bracing. To say the least, the bracing was very bad, but a boiler is being turned out right here in one of the most thriving cities in the State that beats the record, and it it only a question of time when it will likely be the subject of a disastrous explosion.

The boiler referred to is 60 in. diameter × 16 ft. long, with 46 4-in. tubes; distance from tubes to top of shell 18 in., same at bottom. In the bottom of front head and top of back head is a manhole 10″ × 15″, which is strengthened (?) by a ring of wrought-iron, 2″ × ½″.

The bracing of the entire boiler consists of 11 puny braces, 2″ × ½″, two at top and bottom of each head, and 3 in a 36″ domehead. The material and workmanship seem to be first-class. This concern (which has a wide reputation), are turning out just such death traps all the time.

I am looking forward to a time when we will have so strict a license law that men who can pass the examinations cannot be found to take charge of such boilers. Then, and not until then, will boiler makers cease to place such goods upon the market. This is only one of the many instances of the kind all over the country, but I believe in pnblishing such articles to keep continually upon the minds of engineers the necessity of examining boilers before taking charge of them.

W. A. H.

◆

FROM A VETERAN IN THE SERVICE.

Editors ENGINEER:

Thus far on our long journey and all well, and with the most pleasant ship out of New York, no clashing, no discord in any department; in fact it is once more old times. We have had pleasant weather and though deeply loaded, 19 ft. 07″ have made fine time. The assistant engineers pull together, they leave good fires, water in boilers right, and bilges dry; they do not seek to build themselves up by destroying others, a matter which, I am sorry to say, is of too frequent occurrence, as I know to my sorrow from a late experience, when I found 4 ft. 4″ water in the engine-room bilge, after the assistant had gone off watch five minutes; also, the fires left low and burned out. When will engineers learn that this redounds to their personal injury? Each and every engineer who is employed by a company should exert every nerve for its benefit, providing confidence is placed in them by their employers, which is the case on this line. Here no man will be discharged unless it is his own fault, for all are treated with the respect and courtesy due to their positions, from the highest down. I hope for a successful voyage, and from present indications will make it, for there is not a click or a jar in the engines; the boilers are right, and I have a good, competent, and willing crew.

I send you a snmmary of our trip to this place: Left anchorage at N. P. N., 1.30 A. M., Feb. 9, run slow and to signal; 97 + 50 = 147 miles; arrived at Pilot Station, 3.57 A. M., Feb. 14. Total revs. 454,319; revs. per minute, from anchorage to pilot, 62. 4.

St. Thomas, W. I. EDWARD MARSLAND.

◆

M. E. A. No. 76, GRAND HAVEN, MICH.

Editors ENGINEER:

On February 27, M. E. A., No. 76, of Grand Haven, Mich., was organized by C. L. Barron, and the following officers were elected: Henry Blocker, President; James O'Connell, Vice-President; A. R. Mercer, Treasurer; E. F. Bryce, Rec. Secretary; Robert Page, Financial and Cor. Secretary; Patrick Bntler, P. P. and Chaplain; Henry Nyland, Conductor; William Robinson, Doorkeeper. Membership at present, twenty-five.

Grand Haven, Mich. C. L. BARRON.

◆

IN MEMORY OF EGBERT P. WATSON, JR.

AT a regular meeting of *Ocean Marine Engineers' Beneficial Association*, No. 69, the following resolutions were read and unanimously adopted:

Whereas, It has pleased Almighty God in His infinite wisdom to remove from our midst a son of Brother Watson, be it

Resolved, that we tender to the stricken and crushed brother our heartfelt sympathies in his deep and sad bereavement, humbly praying that the blessings of God may richly abound with him, and that he may realize that earth has no sorrow that heaven cannot heal.

Resolved, That we tender to the bereaved mother and sister, wife and children, our heartfelt sympathy, knowing well how inadequate words are to lessen the desolation of their hearts, and earnestly wishing that it was in our power to soften their grief and anguish.

Resolved, That in the death of Egbert P. Watson, Jr., the Marine Engineers' Organization throughout the United States, has lost a worthy adherent, a most efficient and trustworthy son, who was beloved by all his associates; a man ready to aid and assist our fraternity, and one whose endeavors were ever exerted for its prosperity and whose upright life was a standard of emulation to his associates.

J. GEORGE HERMES, President.

◆

FOR what is usually called natural draught in an ocean steamer, the i.h.p. obtained per square foot of fire grate is from 9 to 12. For an "Atlantic racer" with triple expansion engines, worked up to their utmost possible power, the i.h.p. per square foot with natural draught may be assumed as 12. The '*City of Paris,*' with its closed stokehold, gave 15 i.h.p. per square foot of grate, or an increase of power of 25 per cent. An engineer states that fully eighteen months ago he undertook to refit one of a line of steamers with triple expansion engines and one single-ended boiler of three furnaces having 50 square feet of fire-grate, and a total heating surface of 2,338 square feet. From this boiler he undertook to give an average of 1,000 i.h.p. in ordinary working at sea, or 20 i.h.p. per square foot of fire-grate. It was found on trial that the engines gave an i.h.p. of 1,300, or 26 i.h.p. per square foot of grate. The results otherwise were also so satisfactory that the company resolved to have six steamers refitted with exactly the same engines and a single main boiler, and the results have been taken from actual performances at sea, and not from ordinary trial trips. They show on an average a consumption of coal of 1.25 lb. per i.h.p., and 23.66 i.h.p. from each square foot of fire-grate; and if the style of firing which obtains in Atlantic racing steamers were adopted, this could easily be increased to 25 i.h.p. per square foot of fire-grate. Comparing this with the highest natural draught power of 12 i.h.p. per square foot, and 15 i.h.p. per square foot of the '*City of Paris,*' with closed stokehold, it shows an increase of 108 and 66.6 per cent. respectively. The coal consumption in the '*City of Paris,*' has not been published, but 1.25 lb. per i.h.p. per hour is the least known of any sea-going steamer.—*Industries.*

◆

HENRY B. RALPH, second engineer of the tug '*Winslow,*' was discharged by the first engineer, and sued for $76 wages alleged to be due him. Judge Brown, in deciding the case, ruled that the captain of the vessel is the only one who has the right to discharge sailors and other employees. The practice has been for the chief engineer to discharge his subordinates. — *Marine Journal.*

BOILER DESIGNING. No. 2.

By De Volson Wood, Professor Engineering, Stevens Institute.

With a forced draught, like the blast in a locomotive or fan, as in many cases, 100 pounds, or more, have been thus burned; and in practice between 90 and 100 pounds are frequently thus burned. With natural draught the amount depends upon the height of the chimney when properly proportioned in cross section. The higher the chimney the stronger the draught, and hence can draw—so to speak—more air through the grate and fuel. The thicker the bed of coal on the grate the greater will be the resistance to the flow of air through it, requiring a higher chimney to draw the air through. In a strict sense the air is not drawn through, but rather the draught of the chimney tends to produce a vacuum in the upper part of the furnace, and the external air is forced through the grate by the pressure of the atmosphere. The effective head in the chimney also depends upon the temperature of the hot gases in it. By this course of reasoning the reader will get the idea that there is a relation between the height of the chimney, the temperature of the gases in the chimney and the resistance to the passage of the air through the grate and bed of coal, but it would be too mathematical for our present purpose to seek a mathematical formula to express this relation. Peclet determined the resistance and established a formula. It is found in practice that, for chimneys from 40 to 60 feet high, 10 to 12 pounds of coal are burned per square foot of grate, and assuming 11 pounds as the mean, and we find for the grate for our boiler

$$405\div11=37 \text{ square feet.}$$

The depth, for convenience, should not exceed 6 feet, assume it as 5 feet, then will the width be

$$37\div5=7.4 \text{ feet.}$$

Next to determine the square feet of heating surface. As a general rule, the larger the heating surface, the more heat will be abstracted from the hot gases and imparted to the water and steam, but it does not follow that the efficiency will be increased; for the draught of the chimney will depend upon the temperature of the gases as they enter the chimney, and therefore they should not be too low. Also if their temperature should be lower than that of the steam in the boiler before they reach the chimney, all the surface of the flues passed over after that will be worse than useless. As the gases pass from the furnace towards the chimney their temperature is lowered, and the per cent. of heat imparted to the boiler is greatly diminished, and for this reason, the increased first cost of the boiler with an excessive heating surface, and of repairs and deterioration, more than balance the gain in the saving of heat. The highest practical limit of the heating surface cannot be determined with mathematical precision. It is not affected by the nature and thickness of the metal. The rate of conduction through thick plates is essentially the same as through thin ones. The principal resistances depend upon the nature of the surfaces. If these be covered with soot or earthy matter, the resistance may be considerable. The most valuable part of the heating surface is in the furnace or fire-box; and the first foot of the tubes next to the furnace transmits more heat than the next four or five feet. The heating surface is usually compared with the grate area, and the best ratio is found by comparing the results of many boilers in which this ratio is known. A comparatively large table of such results is given in *Mechanics of Engineering*, Weisboch (Du Bois)Vol. ii, in which the heating surface is from 5 to over 100 times that of the grate area; but we find that those cases in which the ratio is about 32, the efficiency of the boiler is as good as when the ratio is much higher. This ratio may then be taken as from 30 to 40 times the grate area, and in our example we will take the mean, or 35; giving for the area of the heating surface $37\times35=1295$ square feet. This is nearly 13 feet per indicated horse-power—a value corresponding fairly with good practice. This will be made equivalent to the sum of the areas of the furnace, the tube plate and flues. The length and diameter of the tubes being known, the area exposed to the flame will be known, and hence the proper number of tubes determined. The clear space between the tubes should be such as to permit a good circulation of water, and this being fixed, the size of the boiler, or length and diameter of shell may be determined. The thickness of the shell may be found from the formula:

$$\text{Thickness.} = \left\{ \begin{array}{l} \text{The radius} \times \text{pressure per square} \\ \text{inch} \div \text{the tenacity of the material.} \end{array} \right.$$

For safety about one-fifth of the tenacity is used; or 10,000 pounds is used for good iron and 12,000 pounds for mild steel.

If the diameter of our boiler be six feet, the thickness of the boiler sheets should be

$$\frac{100\times3\times12}{10{,}000}=0.36 \text{ of an inch.}$$

If the joints be double riveted, 40 per cent. must be added to the above to make the joint of the required strength, making the thickness $0.36\times1.40=0.50$ of an inch.

For mild steel it should be 0.4 of an inch thick. This is for a fine fold security, and it should require a pressure of about 500 pounds to the square inch to burst it.

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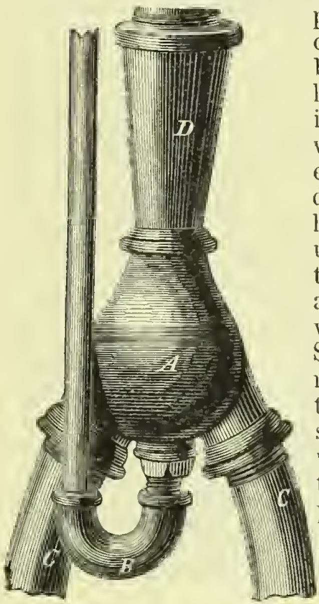
LONSDELL'S PATENT STEAM SYPHON PUMP.



A most useful appliance in all places where any sort of manufacturing is carried on is here shown. In very many cases water collects where it would not pay to put in a pump to remove it, or liquids have to be raised from one level to another in isolated places where steam boilers are at some distance from the locality, but by the use of this apparatus all difficulties are overcome, and work expedited. Steam can be carried to a long distance through steam hose, and with this syphon the work of an expensive steam pump can be done at a nominal cost for apparatus. Especially in steam vessels, yachts, etc., is this syphon of value, for it will drain any compartment in a short time, and can be lowered into places where a pump would be useless. As the action is wholly automatic it never gets out of order and needs no supervision. It will work with seven pounds of steam if required, and will take anything through the pipes that will go through, ashes, rags, chips, waste, "it all goes." This syphon has been in use for some years and is thoroughly guaranteed to do its work. Fuller particulars and prices may be had by addressing John S. Leng's Son & Co., sole agents, 4 Fletcher Street, New York.

◆

We wish to especially commend our contemporary *Industry*, of San Francisco, Cal. It is a monthly journal, conducted by John Richards, a thorough mechanical engineer and a shrewd, close observer withal. *Industry* follows the general lines of all technical journals, but its conductor has opinions of his own, "and, faith, he prents them."

◆

According to a high authority in the English navy, the decision has been made that masts and spars are hereafter to be banished from all its fighting vessels.

BRIGHT'S DISEASE.

Of all the evils which ever escaped from Pandora's box to afflict mankind, it would be hard to find one more terrible in its manifestations than Bright's disease. It is, in reality, consumption of the kidneys, and when of an active type entails fearful suffering. It racks every portion of the body; it affects the sight, and at the last stages changes the very nature and temperament of the patient. It does not always give outward and visible signs of its presence. Very many go through life with Bright's disease without suspicion of its presence. Men have died at sixty years of age with Bright's disease after a life of activity and exposure. Many more die of it in early life, and after a few years' experience of it; but when of a virulent type it is certain and speedy death. It attacks persons of the most regular habits and simple living, and gives little or no warning until some function, or sense, by failing, shows that there is organic weakness. There is absolutely no safeguard or preventive known for it. In the words of capable physicians it is incurable. In a case which recently came under our notice the patient was a young man of twenty-seven years. All his habits were correct and simple to the last degree. He was a model of strength and endurance, being six feet in height and heavy in proportion. He had never had a day's sickness in his life; he gloried in his immunity from the evils which befall mankind, and laughed at sickness as beneath his notice. Heat or cold, wet or dry, was all the same to him, and he drove through all unharmed, apparently without disaster. In October last he noticed that his sight was curiously affected, saying that street signs appeared all right for the first portion of the letters, but the last portion ran off into zig-zags which were undecipherable. He thought nothing of it at the time, but was compelled to consult an oculist as to the cause. This person said that if it was simply the eyes, it was a matter of little moment, but he demanded to see the secretions of the kidneys. These being shown him the oculist told the young man that his days were short in the land, that he must wind up his affairs and prepare for death. That is Bright's disease.

◆

HORSE-POWER OF BELTS.

We are getting wearied of rules for "the horse-power of belts." They nearly all relate to so many "feet per minute of one inch in width," and a variation of velocity to compensate for quality or the condition of belts. Now the whole of these rules, so far as we have examined them, can be resolved into so many superficial feet of belt for a horse-power, that is, the superficial feet passing a fixed point in a given time. If this is assumed then the variations of quality can be provided for in a natural way, by allowing a greater or smaller number of feet for a horse-power, without interfering with velocity, which is a non-variable quantity and should never be employed as such in computing the power of belts. The true variable is surface. Anyone can compute in a moment's time how many square feet of belt passes a fixed point, per minute. If a belt is twelve inches wide, then every foot of movement gives a foot of surface; if six inches wide, two feet of movement gives a foot of surface, and so on. This found, the following table furnishes divisors for horse-power, as nearly as any general rule will apply.

Leather Belts, Single Thickness.

	1 H. P.
On Smooth Iron Pulleys	80 feet
On Wooden Pulleys	65 feet.
On Covered Pulleys	50 feet.

Gum Belts, Average Thickness.

	1 H. P.
On Smooth Iron Pulleys	60 feet.
On Wooden Pulleys	50 feet.
On Covered Pulleys	35 feet.

—*Industry, San Francisco.*

◆

Work like a man; but don't be worked to death.

THE ENGINEER.

FORTNIGHTLY. . . $2.00 PER ANNUM.
Foreign Subscriptions, - . . . . . 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, MARCH 15, 1890. No. 6.

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Entered at the New York Post Office as Second Class Matter.

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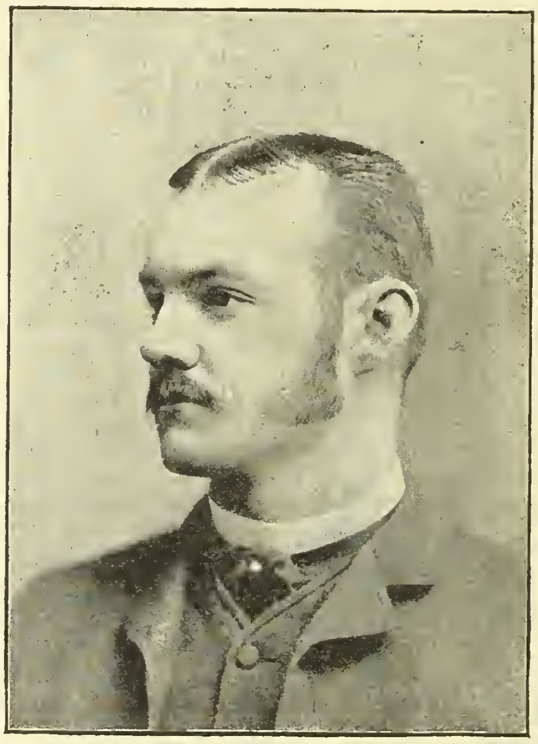
IN MEMORY OF EGBERT P. WATSON, Jr.

IF, in this memorial, I seem to eulogize a man who was for twenty-seven years my constant companion, it is for the reason that he was worthy of eulogy, and not because he was my son. In all this time he was never far away or out of my sight for long periods. Even when he established his own home it was within a few minutes of my own, and therefore I say that he was my constant companion. During this time I learned to know him as one man knows another, and it is only in that way that I here speak of him.

In every relation of life Egbert P. Watson, Jr., was without fault. He was courageous, honorable, and true to every trust confided to him. Physically he was above the common stature, and he was as great morally as he was physically. The man does not live who can say that Egbert P. Watson, Jr., ever wronged him, wittingly or unwittingly. His was the heart ready to respond to any appeal, and no one ever asked aid of him of any kind that it was not cheerfully given. He had the bravery and physical courage of a strong, thoroughly balanced man, and when sentence of death was pronounced upon him by a physician only a few months ago, (he had never known a day's illness before,) he accepted his lot without a murmur or complaint. He knew that his end was certain, and that he must soon bid adieu to all that earth contains, yet he continued about his worldly affairs until he was absolutely compelled to stop from physical causes. It is easier to lead a forlorn hope in battle than to see death approach stealthily in civil life, and to know that at any time it may cease, for in the one case the agony is short, while in the other it continues for indefinite periods; yet this is what Egbert P. Watson, Jr., had to encounter. Just in the morning of life, with talents and abilities of a high order, with a lovely family about him, he was told that he must leave all and enter an unknown world. He was equal to the ordeal, and he went through it with the fortitude of a Christian martyr. If he had not been my son, I would have been proud to have known such a man, and no one can look upon the face here published and not see that every word of this memoir is borne out by it. It is full of high courage, nobility of sentiment, intellectual force, and unswerving integrity. As a human face it is a beautiful one, as an evidence of character it is unimpeachable. He could face all mankind as steadfastly as he looks forward here.



Friends, mourn with me for the man who is gone, and bear with me while I lament my dead. The voice of nature cannot be hushed, and knowing that you would share my sorrow with me, I have laid aside conventionality and spoken as man to man. Personal friends, both mine and my dead son's, will please accept this public acknowledgement of their kind sympathy and condolences in lieu of a direct response. Many of these friends I have never seen, but their kindness is none the less felt.

EGBERT P. WATSON.

DIRECT ACKNOWLEDGMENT.

WE are under the greatest obligation to professional friends who have come forward and offered their services in our distress. Knowing that we were in no condition to do technical work, they have volunteered to assist us, and have done so nobly. We cannot express our thanks in words, but we feel their kind offices deeply. It is only in the time of affliction—when the foundation of our being is searched—that we realize how artificial are social boundaries, and that all mankind are one great family, moved by the same emotions and sharing one another's sorrows.

OBLIGATIONS OF PARENTS.

No one who is in the least interested in mechanical or engineering matters can fail to find much that is interesting, and instructive as well, in the articles on John Ericsson in the February and March numbers of *Scribner's Magazine*. They are written by one whom Ericsson himself wished to write his biography if it should ever be written, and in them are brought out many facts relating to the antecedents and development of the man which serve to throw much light upon the source of his power, and help us to better understand why he was able to accomplish so much during his lifetime. Many of the points brought out are worthy of attention, but one of them will, for the present, suffice, and it is the one which illustrates very strongly the responsibility of those who, as parents, have intrusted to their care and guidance talents which properly encouraged and stimulated may leave a broad and honorable mark upon history, but if misundersood, misdirected or discouraged, may possibly make the life of a naturally talented child one continuous disappointment both to himself and his friends.

It is true that John Ericsson's genius was of that order that would have inevitably made him famous, in spite of almost any obstacle that could have been brought against him; but, nevertheless, it is easy to see how much he gained both in time and in the grandeur of his ultimate achievements from the fact that he was so fortunate as to have parents who did not consider their obligation to him fully discharged by simply keeping him clothed and fed, but, who, recognizing his natural talents, made sacrifices in order to prepare him for the future full exercise of those talents, and saw to it that by early training and instruction he was provided with the best possible foundation for what they seemed to clearly foresee would be his future career.

In his more mature years, when the character of Ericsson had fully developed, discouraging circumstances or active opposition only seemed to make him more determined and in the end more completely successful, but the fact that at the age of twelve years he was an accomplished draughtsman and at fourteen possessed a better education and more knowledge of engineering than many who are considered full-fledged engineers, must, after all due credit has been given to his own uncommon natural abilities, be attributed chiefly to the discriminating appreciation and the self-sacrificing devotion of his father and his mother, both of whom the world has cause to remember with gratitude.

History is full of instances of men who though they finally achieved fame, commenced the real labor of their lives, for which nature evidently designed them, after years of misdirected and utterly fruitless labor in a calling to which they had been assigned by the carelessness, the blind stupidity, or the vanity of their parents. The final success of these men has often been referred to as an illustration of the old but untruthful saying: "Where there's a will there's a way." But however successful these men may finally have become,no one can say how much more successful they might have been under more favorable circumstances.

There is little doubt that it lay within the power of Ericsson's parents to have kept him in profound ignorance of all that pertained to mechanics or engineering up to the age of twelve years. Previous to that age no boy develops aggressive powers sufficient to overcome the determined resistance of parents bent upon preventing him from following the course to which he seems inclined, and very few are able to accomplish much without their assistance, or the assistance of those who stand in their stead. Had Ericsson possessed parents who were ignorant of the nature of the talents entrusted to their care, or, indifferent to them,he would, at this age, have been simply an unusually bright and ingenious boy; but as it was,he was this and much more besides; he was a competent engineer, and had accomplished things which brought him to the favorable notice of those who afterwards did much to further advance him. However much he might have accomplished under other and more favorable circumstances—and no one can doubt that he would have accomplished much—it is quite certain that a large proportion of what he did is due to the fact that his parents understood and appreciated his genius and cheerfully discharged the obligation.

All honor, then, to Olaf and Brita Ericsson, who were as faithful in the discharge of the duty lying before them as was their immortal son John. To them humanity owes a vast debt of gratitude; how vast, we can only imagine. AMICUS.

◆

MERE MONEY.

A FEW weeks since a man who had a great deal of money died and left it all behind him. He brought nothing into the world, and took no more out of it than he brought, but in his life time he held the key to the world. Judging by his portrait as published,he unlocked nothing with the key, that was of any value to himself or others. His was a stolid, imperturbable, self-satisfied face, and the expression of it as matured and set—for he was an old man—shows that life was endurance to him, and not performance. Whether he made the most or the least of his opportunities, is not for us to judge, and if we made any commentary at all, it would be upon the superficial evidence of the portrait. Physiognomies are misleading many times; often, however, they give an insight into human nature, and the testimony of this face we speak of is that, as a means of happiness, gold is of no value. The sources of happiness are in the man's mind and nature, and not in his pocket book. "Man heapeth up riches and cannot tell who shall gather them," and if he spends his life in simply putting one dollar on another he has been a poor steward. If all a man gets out of this world is measured by the amount of money he gets in it he does not get much, even if he gets millions.

FASHION'S CALL FOR COMPOUND LOCOMOTIVES.

BY A LOCOMOTIVE ENGINEER.

WE do not believe that there ever has existed any urgent necessity for designers wrestling over the production of compound locomotives, but nevertheless, our master mechanics and locomotive builders are following the fashion set by their compeers in Europe, and there will soon be a number of American built compound locomotives at work. The compound locomotive of the Webb pattern imported by the Pennsylvania Railroad Company appears to have set many of our railroad men into a state similar to that which overtakes the female community when a new bonnet of a particularly aggressive pattern makes its appearance direct from Paris. Every railroad company could not enjoy the expensive luxury of importing a compound locomotive, but many of them could produce a home-made imitation, and this is going on in various quarters. The Baltimore & Ohio Company have had a compound locomotive at work for some months, with no great promise of any advantage being reaped from the change. The Michigan Central Company are running a compound locomotive, whose principal merit is that she differs very little from an ordinary passenger engine, and several other railroad companies have new compounds in course of construction. Meanwhile, the Pennsylvania Railroad people are not shouting very loud about the virtues of the English compound that they have had at work (mostly in the round-houses) for nearly a year.

If the railroad companies had exhausted every means of making the simple locomotive as economical a machine as it was in the power of engineering ability to perfect, and the limit had been reached, we would have readily admitted that the next move of progress was in the direction of compounding; but nearly all of our railroads are far behind this limit, and there is danger that the ambition to make locomotives use the steam in a complex fashion, may blind those concerned to obvious means of making the simple engine a more efficient machine. The maximum saving claimed for compound locomotives ranges from 15 and 25 per cent. of fuel. Where coal is fairly cheap this amount of saving may very readily be swallowed up and more with it in the increased expense of repairs. There are very few of our railroads where a saving of 20 per cent. is not possible by merely stimulating the enginemen to increase of care in doing their work. We should think that some method of permanently keeping up this stimulus would be tried before new and expensive designs were introduced.

While taking this common sense ground, we are by no means opposed to the compound locomotive as a manifestation of mechanical progress. We merely wish to see the way prepared for it as the way was prepared for the marine compound engine, by first doing the very best possible work with the simple type of engine. The means by which success was attained in the use of the compound marine engine might also furnish useful lessons to the men likely to be held responsible for the future of the compound locomotive. The compound engine has been so long worked out in all its details, that there is very little ground remaining for the foundation of valid patents, and on this account it will be hard to saddle compound locomotives with patents on useful attachments. Inventors are, however, industriously at work, and it will not be their blame if railroad companies that indulge in the luxury of compound locomotives are not required to pay heavy royalties on patented connections or designs. The most successful compound marine engines have been noted for the simplicity of their parts. The mechanism used for simple engines was as far as possible retained for the compounds, and there was little in the changes made that would put the men in charge at a loss to understand. We predict that the compound locomotive that comes nearest in design and method of operation to the simple locomotive will meet with the greatest measure of success.

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THE ADULTERATION OF THE BOILER.

IN another part of this issue a correspondent calls attention to well-known facts in regard to boiler making which are all too common. It seems easy to find a remedy for them, but it is, we think, impossible to prevent the abuses complained of, unless we alter human nature. There is always a portion of the community who judge of things by their first cost, not at all by their real value. It matters not to them that a thing which is sold at a low price is not cheap, but actually costs more than the genuine article at a fair price. These are the people for whom clothing dealers advertise $50 suits at $12 50, alleging that financial cataclysms constantly occurring enable them to make such prices. The average steam user means to buy his boiler as cheaply as he can. It looks strong, has just as many rivets outside as any other, and is just as good to him as if it were made out of the best iron instead of the worst, and put together by skilled workmen instead of cheap labor. No one can convince the buyer of cheap boilers that 25 per cent. more would buy a 50 per cent. better boiler, and there is no law which can be devised to prevent the sale and manufacture of cheap boilers. We need not look to license laws for help in this matter. The license law is strong enough now, but there are constant evasions of it all over the country. When the laws of the land permit a steam user to buy a worn-out, second-hand boiler, repaired with varnish on the outside, and chock-a-block with mud inside, allow him to set it up and run it as long as he likes in a crowded city, it is useless to talk about preventing the sale of new cheap boilers. If anyone thinks we are overstating matters, let him go and protest against some steam user in any large city who is reckless. If the complaint is heard at all, some police justice, or justice of the peace, will say that the boiler is all right; it has not exploded yet and that will be the end of the matter; the complainant will be lucky if he is not saddled with costs. The difficulty in the way of reform lies in the fact that the public at large are not engineers, and cannot see that they jeopardize their own lives and that of others in the vicinity by cheap boilers.

If there was an autocratic, one man, engineer-power at the head of municipal affairs, and his sole object was to displace every bad boiler in use, his life would be rendered miserable and existence impossible, by reason of the evasions and disobedience of his orders by those interested in unsafe boilers.

We cannot have things all our own way in this world, or any other, notwithstanding our way may be the only right one.

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AMONGST other things the late G. A. Hirn turned his attention to the important economic question of the lubrication of machinery, and upset the previous prejudice against the use of mineral oil for this purpose. He also demonstrated experimentally that, while the old laws of friction enunciated by Morin were sufficiently accurate for the contact of one dry metal against another. these laws are powerfully modified when the surfaces are well lubricated, as with machinery. Now the friction varies as the square root of the pressure, and as the surface and the velocity; so that the theory falls in with that of the viscous flow of liquids. These laws have received confirmation of recent years by the experiments carried out under the auspices of the Institution of Mechanical Engineers.

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ENGLISH trade journals are outdoing each other in illustrating the Forth Bridge. *Engineering* has issued an enormous volume on the subject which covers it in all details.

Foreign and Domestic Trade Literature.

CYLINDER LUBRICATION.

The old style of oiling the valves out on the steam chest has about gone out of use, for which we are thankful. Most of the firemen of to-day know but very little about crawling out along the run board on a pitch dark, cold winter night, hanging to the hand rail with one hand and to a pot of hot tallow with the other, when the engine is rocking about and making a 40 mile gait down some grade. About the time you would get turned around straddleways of the brace from the smoke arch to to the pilot beam, ready to hunt for the opening in the oil cup on the chest—biff! a big drift of snow would be met, some of which would go up inside of your clothes—lots more down your neck, and the tallow—where did that go? Lots of it went everywhere but on the valve seat. Once in a while the fireman lost his grip when going over a run board or front end piled up with snow, so that he slipped off and was killed or maimed for life. The extension front ends were nice things to lean up against, too, when they got hot enough to burn paint off in one trip, but a man could not get around them at all.

When oil pipes were put on, leading from the cab to the steam chest some master mechanics did not think it right to put them under the jacket where they were out of the way and would not freeze up, because, if anything went wrong with them, they could not be got at without taking up the jacket. They were nice things to touch when it was necessary to go out on the running board during a trip, if they were not frozen solid. Thanks to a more enlightened view of the safety of others, or to the fact that there was so much opposition on the part of the men on the engines about going out to oil engines that a man must unnecessarily risk his life to oil, the valves are getting to be "back numbers."

From the way sight-feed lubricators are being put on the locomotives, it is only a question of time and money to pay for them, when every locomotive cylinder will be oiled by them. There is a prejudice on the part of some against a sight-feed. When you see some of them with a half dozen pipes running all ways over the boiler head, gum and dirt over all, a few of the numerous joints leaking, and the oil from both feeds going into one cylinder, you don't wonder. The manufacturers say that they won't "cross feed" or send the oil all over through the condensation pipes and reservoir to one cylinder, but some makes of sight-feeds, where one cup feeds both cylinders through independent pipes, do it just the same, and I have heard of them feeding into the boiler through the steam supply pipe. Some of them are constructed so that when the pipe gets stopped up anywhere between the glass and the steam chest, the oil will quit feeding on that side. There is, however, a remedy for most of these troubles at the disposition of the man on the engine. Keep your oil clean, strain it, if necessary Run a little swab, wet with glycerine, through the sight-feed and oil glasses, and it will keep the oil from sticking in the glass. If you use a patent mixed valve oil that gums up, blow it out clean once in a while. Some use a strong solution of concentrated lye, and leave it in over night. That cleans out the cup and starts some of the joints leaking if they are not made good, and eats up the rubber gaskets.

One advantage of the sight-feed is that the oil can be fed in steady, up hill and down, whether shut off or working steam, in slow drops or almost a stream. There is another advantage which is lost sight of by some. The oil is atomized or delivered on the valve in a spray, instead of in bulk, a teaspoonful or a cupful at a time. One thing I would like to have explained, why ordinary black oil, and the poorest kind of car oil at that, fed through a lubricator, does just as well in a cylinder and on a valve seat as the more expensive patent valve oil.—*Locomotive Engineers' Monthly Journal.*

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TRADE SECRETS.

It often becomes a matter of some importance to an inventor whether he should keep an invention to himself or obtain protection by Letters Patent. The question is frequently asked, is it worth while to patent an invention? This resolves itself purely into a matter of profit and loss. A manufacturer, however, has frequently to consider whether he cannot get more out of his invention by keeping it to himself. One course or the other must be adopted at once, as the profitable use of an invention will preclude him afterwards from obtaining valid Letters Patent. It is true that the product does not necessarily reveal the machine or the process by which it was made, but the rule is founded on public policy. An inventor in England is not allowed to practice his invention for, say, four or five years, and then, finding he can keep its secret no longer, apply for Letters Patent.

There are some inventions which, from their very nature, it would be preposterous to treat by way of trade secret. There are a few inventions consisting of processes which are capable of being so dealt with. Even in such cases, if an inventor wants to do anything beyond manufacturing in his own works he must patent. If, for instance, he wishes to license, or sell, either at home or abroad, he must patent. It is evident that, for all practical purposes, a trade secret is not a negotiable property. The great advantage of a trade secret is that the owner has the most perfect monopoly, *while it lasts.* If Letters Patent are applied for, rival manufacturers are at once informed of the new departure. The inventor may have to protect himself by expensive litigation. One advantage of a trade secret is that there is no fear of other persons obtaining a compulsory license of the invention. There is always present the disadvantage consisting in the risk of disclosure, but there is the possibility of a longer monopoly than fourteen years, which is the limit of Letters Patent. There are many cases in which inventions have been worked as trade secrets for years. In more than one case which has came to our notice an invention has been lost on the death of a partner or foreman who knew it. The great practical objection to a trade secret is the difficulty of keeping it secret. There have been successful instances where it has been done in mechanical cases by dividing the work amongst a variety of hands, so that one hand only knows the details, and not the entire work. In the glass and china trade there are instances of trade secrets having been kept for many years. In these cases the invention has been in the knowledge of the principal, and perhaps his manager. In the manufacture of alloys trade secrets have been kept for years.

There are some cases where, to insure the secrecy of processes, operatives have been chosen for their dullness or want of perception; chemical substances have been disguised and misnamed; the dials of pressure gauges have been altered, and the scales of thermometers have been graduated on a false basis. These expedients have, to a certain extent, proved successful; but where, however, the invention is known to the operatives, the risk of its disclosure is very great. The most effectual means of preventing such disclosure is to retain a part of the wages. It is the custom of one large firm, not only to divide the work, but to retain, in addition, a part of the pay (known as "bonus pay") for three years. This has the effect of keeping the men in the master's employ; and the pay is forfeited if they enter the service of a rival manufacturer. Where this system of deferred pay is in force, the men, on entering, are actually sworn in to keep the secrets of the business. The retention of a part of the pay is a most powerful weapon. Sometimes trade secrets consist of workmen's expedients or trade tricks, which do not amount to the dignity of patentable invention. Patents should, of course, not be applied for in such cases.

There are a great number of large works in which a stranger is not allowed to enter; on the other hand, however, there are large works where the entry of strangers is quite disregarded. Sunday afternoon is a very favorite time for visitors to go over works. The inquisitive stranger has plenty of time, little fear of being disturbed, and absolute quiet; there being no one about except, perhaps, a furnace-man who has to look to his fires on Sunday afternoons, and who has probably been the means of the intrusion.

Where there is an honest watchman, the stranger may find greater difficulty. There are some manufacturers who prefer to pay the police for extra external watching than to trust to a watchman inside. This method of robbing a man of his industry is most unfair and discreditable. It is impossible to come to any other conclusion, having regard to the clandestine way in which the information is obtained. Confidential assistants are bribed; operatives and mechanics are decoyed into the service of a rival manufacturer; works are visited against the wishes of the owners—acts which no honorable manufacturer would sanction. It may be said that these expedients are sanctioned with a view to the detection of infringements. The most casual observer will see that the object in view is different. There is a great distinction between obtaining information for the purpose of stealing another man's industry and gaining information for the purpose of detecting infringements and so securing to the patentee what the Crown has allowed him.* * *

A consideration of the foregoing shows that it may occasionally be good policy for an inventor to keep an invention a trade secret. Of course, no hard-and-fast rules can be laid down; but in practice it can only be done where the inventor merely wishes to have the use of his invention himself, and where there is a reasonable chance of keeping the invention secret. The balance is greatly in favor of a patent, now that the question of subject-matter is so well defined.—*Industries.*

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SCHOOLROOM MECHANICS.

It must be admitted that the present systems of elementary education and of apprenticeship are not at all designed to the best advantage of either the masters or the apprentices. The mechanical mental drill of the schoolroom has not been found to produce intelligent and active-minded boys, and is in danger of leading to the substitution of equally mechanical manual drill—in fact, into the conversion of the elementary schoolroom into a toy workshop, and of the secondary school into an establishment for the training of apprentices, as is now being done to a considerable extent on the Continent and in America. Such trades or craft schools have their uses, especially in the smaller and more artistic classes of work, but if the employers of labor neglect their evident duty in arranging for the training of a due proportion of apprentices, and so render such schools necessary, it is their business to support them, and not expect that to be undertaken at the public expense. The cry for improved technical education has met with a feeble response on the part of the workmen, as they think, and, in fact, as they say plainly, that the whole movement is intended for the benefit of the employers, and to relieve them of their proper duties; and it must be admitted that to a large extent they are right. If employers of labor had continued to take even a small personal interest in the education and welfare of their apprentices, we would not have heard much of the cry for improved technical education. This could have been done at a comparatively small expense, and at very little trouble. In some of the more artistic trades, as already explained, special schools, or classes in existing schools, might be necessary, especially where the work was subdivided to a very large extent, but for the most part the apprentices could get all the theory they want in the ordinary classes for science and art, while the workshop or manufactory would continue to afford opportunities for obtaining the necessary practical skill. Success in any trade or profession does not depend so much on the amount of information which may have been crammed into the learner's head as is often supposed. Lord Armstrong recently pointed out that it depends incomparably more upon his capacities for useful action than upon his acquirements in knowledge, and he therefore urged that the education of the young should be directed to the development of faculties and valuable qualities rather than the acquisition of knowledge which may be deferred to more mature age. British engineers and British workmen generally have been able to hold, what their Continental neighbors consider more than their own, chiefly on account of their good practical training and sound common sense, two qualities which are not always possessed in any great degree by those who have spent an undue proportion of their time at schools or colleges. These may make arrangements for more systematic instruction in the different parts of a trade, but they cannot impart the true spirit of the successful manufacturer, which is only to be got in the atmosphere of the actual workshop. Therefore any system of training which keeps the young men or women from actual contact with the conditions of every-day work should not receive any encouragement, not only on that account, but also because it relieves employers from what ought to be part of their recognized duties, and tends to perpetuate a stereotyped form of instruction.—*Prof. Dyer.*

LATEST FACTS ABOUT ALUMINUM. No. 2.

Pure aluminum melts and becomes fluid at about 1,200 degrees Fahrenheit. The amount of impurity in aluminum materially alters its melting point. One per cent. of iron raises the melting point over 100 degrees. It does not remain firm like lead almost to the fluid point, and then suddenly give way, but has a stage of from 1,000° Fahrenheit to 1,200° Fahrenheit in which the metal becomes pasty, loses much of its power of cohesion, and during which stage, if the metal be gently pressed together, it can be readily welded. It is, however, very red-short at this temperature, and will not stand hammering to weld the metal, without crumbling down. If the metal is not held too long a time in this pasty condition, it does not seem to become injured after being again cooled down. The melting point of aluminum, as given by Roscoe & Schorlemmer and by Mierzwiski is 700 deg. C. or 1,292 deg. Fahr.; by Deville at a temperature higher than zinc and lower than silver; by Fahquhardt at 760 deg. C. or 1 400 deg. F. Mallet says that pure aluminum is more infusible than impure.

Aluminum, in a compact mass, is an absolutely "fixed" metal at any temperature attainable by combustion of carbon in the most approved furnace, although in thin beaten foil aluminum burns in a current of oxygen gas· Aluminum had best be melted in first-quality plumbago crucibles, from which it absorbs only about 0.25 per cent. of silicon with each re-melting. In melting in clay, Battersea, or other silicious crucibles, aluminum becomes very seriously contaminated with silicon. For purposes where it is especially desirable to retain the purity of aluminum, it is best to re-melt in crucibles brasqued or lined with a mixture of finely ground, "dead burned," calcined, pure magnesia, with just enough boiled tar to give it sufficient plasticity; this mixture entirely preventing the molten aluminum from coming in contact with the silica in the clay of the crucible walls. Aluminum is most malleable at a temperature between 200 and 300 degrees Fahrenheit, although it can be rolled cold, with frequent annealing. It should not be worked at a temperature above 400 degrees Fahrenheit, for it becomes very red-short at a temperature a little above this point. Aluminum becomes quite hard by work upon it, either by cold rolling, hammering, or drawing. Through wire dies, it assumes nearly double its normal testile strength, although it does not, like steel, lose proportionately as much of its "ductility" as measured by the flow of the metal in reduction of area at point of fracture. In rolling or drawing aluminum, like the precious metals, it requires frequent annealing to prevent its cracking. This annealing is accomplished by heating the metal to a temperature of about 800 degrees Fahrenheit. It is a temperature at which a thin bar of iron placed in the muffle will just appear slightly red, on a dark day at twilight. The aluminum at this temperature should not appear at all red. This temperature can best be determined in a practical way by drawing a soft pine stick across the surface of the aluminum to be annealed; it should leave a black mark from the charring of the wood, which should burn off very slowly or not at all. After being heated to this temperature, the metal should be allowed to cool off very gradually, although a very satisfactory annealing of light articles can be attained by plunging them in water of between 60 and 100 degrees Fahrenheit. For some articles where it is necessary to keep the heat down below the point where the metal would sag or lose its shape, a very satisfactory annealing can be done by heating the articles in boiling linseed oil and allowing them to gradually cool with the oil. Very thin sheets and wire can be annealed by plunging into boiling water and allowing to cool with the water. Aluminum annealed is very soft and pliable indeed—in fact, as compared to its tenacity, it is probably the most pliable of metals.—*Hall, Hunt and Langley.*

VARIATION IN FUEL CONSUMPTION OF LOCOMOTIVES.

THE wide variation in the fuel consumption of different locomotives doing precisely the same work is continually a matter of comment. So far as the evaporation of water by locomotive boilers is concerned, one must admit that little information is extant which is reliable. The best proof of this lack of information is in the wide variations in the results. For instance, some locomotives with cramped steam spaces, and which have to be forced in service, show an evaporation of between 8 and 10 lbs. of water for each pound of coal consumed. Others having large steam spaces and of better general design than the first, and which have not to be so violently driven in operation, show an evaporation of only 5 lbs. of water per pound of coal, the results in each case being obtained by dividing the water used by the coal consumed. Throwing aside all differences possible by leakage and loss through the overflows of the injectors, there still remains a large difference to be accounted for, and which in most cases is in favor of what would seem to be, in the eyes of experienced railroad men, the inferior boiler design. Perhaps the cause of the difference may not be so hard to find if recent developments in cases of locomotives having cramped water spaces be used as a foundation for argument. Several instances of this sort have recently been brought to attention in which a considerable percentage of all the water passing into the boiler was not evaporated, but passed into the cylinders in the form of vapor, the presence of which can only be discovered by careful watch of the top of the smoke-stack during exhaust and by the action of the indicator piston, and this only in extremely bad cases. Large amounts of water can thus pass through the boiler without being perceived in any way. Stationary engineers are well aware of this action, and they do not consider evaporative tests of boilers as satisfactory unless accompanied by accurate observation with some sort of calorimeter test of the character of the steam generated; particularly do they consider it necessary in the case of comparison of water tube or other rapid circulation boilers with boilers having a slow circulation and large steam spaces. The locomotive boiler in use operates under conditions particularly conducive to the formation of a water spray which is taken up by the steam and carried over to the cylinders; and one of the pieces of apparatus which is most needed in connection with locomotive tests is a calorimeter adapted to locomotive work, to measure the actual evaporation rather than the apparent, which is that generally stated. This subject is one which has been well considered by the marine and stationary engineer in all countries, and by the railroad engineers in France, as is well shown by the locomotive designs at the Paris Exposition last year. In England and in this country this question needs more consideration. To appreciate this any superintendent of motive power having a variety of locomotives in use need only compare the ratios between the steam space capacity in the various locomotive boilers with the respective amounts of steam demanded per minute from those boilers. One case has recently come to notice where a change in the boiler dimensions reduced the coal consumption from two tenders full to one for the same run under the same general conditions.—*Railroad Gazette.*

SENIORITY IN PROMOTING FIREMEN.

As a rule, railroad corporations want men of unquestioned competency to fill every department, and in no department is the requirement of greater concern than in the moving of trains.

Railroad officials study their employees with special reference to promotion, because responsibilities increase with every advancement, and it is at this point that merit assumes special prominence. It is also at this point that the claims of seniority are supposed to have preponderating weight. It may be said, in the way of illustration, that a railroad official who has the appointing power wants an engineer, and that the policy of the road is to promote firemen. Suppose there are twenty firemen on the road, that five have been in the employment of the road three years, five four years, five five years, and five six years. The five who have been in the employ of the road six years are the seniors of the other fifteen, hence the claim that one of their number should be promoted. Manifestly, all things being equal, there can be urged no good reason why anyone in the ranks below six years' service should be promoted over the seniors. Under such circumstances to disregard seniority smacks of rank injustice. It demoralizes the entire force. It is the worst thing that the official could do. It is suggestive of unworthy motives. It is a crushing blow aimed at honorable ambition. Firemen say, and are justified in saying, that the promotion was secured by dishonorable means; that the official had been influenced by considerations of the most vicious character, involving the manhood of the man promoted.

That is one side of the case. But there is another side of the subject of still greater gravity. In the case under discussion seniority may mean nothing but mere years in the employment of the road—merely a question of time. The man who has been a fireman six years is the senior employee of the man who has worked only five years, and so on down. When the time comes for promotion there should be, and there will be, other questions asked besides those which relate to years. It is right and proper that such should be the case, and the fireman who has been watchful, studious, honorably ambitious to succeed in his chosen calling, who has husbanded his time and his money, and who has established his reputation for intelligence, though he may have served but five years, or four years, or, indeed, three years, may be better equipped for the position of engineer than the man who has served six years, and has neglected his opportunities to improve his mind and add to his store of knowledge, and we hold that, under such circumstances, merit, and not seniority should influence promotion.

If men aspiring to promotion are unable to comprehend the value of equipment in its largest and best sense, and rely solely upon seniority for advancement, they should be taught that something more is required, and this lesson they are likely to learn to their great disadvantage.

Taking a broad view of the subject, we come to the conclusion that seniority may be justly urged as a prior claim to promotion when qualifications are superior or equal in all regards to those of aspirants who have a less number of years of service to their credit.—*Locomotive Fireman's Magazine.*

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STEAM ENGINE EFFICIENCY.

* * * The true standard is the maximum efficiency that there is a possibility of getting out of the steam engine, on any hypothesis consistent with fact. It may be easily shown that the maximum efficiency would be obtained with clearance spaces *nil;* the steam so far superheated, or the cylinder walls kept so hot that no condensation, and consequently no re-evaporation, could take place in the cylinder, and the range of temperature fixed by rational working conditions. The lower limit is easily fixed; we know that it cannot be got below 100 deg. Fah. The maximum temperature is more difficult to settle. Mr. Collinson Hall once worked a steam engine at a pressure of 1,000 lb. on the square inch. Mr. Perkins has worked at 500 lb. It will, however, answer every purpose if we take 300 lb. pressure absolute, corresponding to a temperature of 417.5 deg., as the maximum. In a Carnot engine working within these limits, the efficiency would be .361. In the real engine the steam would be expanded about 100 times. It would not be impossible to construct and work such an engine, but its efficiency would be far less than .361—so much less, that to draw a comparison between it and the Carnot engine would be simply absurd. The actual possible efficiency of such an engine might be established, and with it other engines might be compared. We shall show presently how such a standard may be prepared; but before doing so, it is essential that what is meant by the term "efficiency" should be rigorously defined.

Unfortunately the term "efficiency," as applied to steam engines, is employed vaguely by both writers and speakers. It is not so much that the meaning of the word is not fully understood, but that there are several meanings. We have first "indicated horse-power," and secondly "brake horse-power," in common use. The steamship owner estimates efficiency in terms of miles run with a ton of coals. The locomotive superintendent determines efficiency in pounds of coal burned per train mile. Each of these definitions has its use, but this use is more commercial than scientific, and the proper definition of efficiency for scientific purposes is no doubt what Hirn has very appositely termed "absolute efficiency;" and it is by this, and this alone, that the merits of a steam engine should be gauged. We can easily ascertain what is the maximum absolute efficiency that a given steam engine could have, and with this we can compare the absolute efficiency of a real steam engine. There will be a difference. The latter will be less than the former, and, by tracing out the causes of the difference, we shall learn a valuable lesson, and possibly arrive at conclusions which may lead to important improvements.—*London Engineer.*

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THIS is the beginning of a letter in a foreign paper:

SIR: I pass over the crude and undisciplined jokes of your correspondent "Z. Y. X.," in order to correct his gross misrepresentations, etc., etc.

A joke which requires disciplining is a serious matter.

THE FRENCH CRUISER 'FORBIN.'

WE have seen a good many foreign men-of-war, but have so far seen nothing that has compared in appearance with the '*Chicago*,' U. S. N. She may not be very formidable, but she is certainly very handsome. She attracts attention and excites admiration wherever she goes. A great many French officers have been on board within the last week, and they are even more enthusiastic in their expressions than were the English officers at Gibraltar. One does not wonder at this after seeing a few of their ships of a similar class. It happens that there is now lying very near the '*Chicago*' a French unarmored cruiser of almost exactly the same length as the latter, although of much less displacement. This is the '*Forbin*,' the latest ship launched for the French navy, and therefore representing the very latest development in French naval design. She illustrates in its extremest form the modern craze for tremendous speed, and the willingness to sacrifice everything else to this one requisite. She has made a record of over 20 knots speed. When that has been said all is said, for she has not another single point that it is possible to admire. To give weight for her engines she is built so lightly that it is difficult to see how she could hold together in a gale. Her frames and beams are of $\frac{1}{8}$ inch steel, and she is sheathed inside with linoleum (oil cloth) instead of with wood. Her armament is so light as to be of no value except that it might, perhaps, enable her to capture a merchant steamer if the latter were wholly unarmed. The quarters for her officers and men are worse than those on our '*Yorktown*'; that is to say, they are as bad as they could be. She is called a cruiser, but she can never be used for anything but a dispatch boat. It is not surprising that her officers were pleased with the solidity, the spaciousness and the comfort of the '*Chicago*' and with the weight of her battery. As far as it is possible to judge from the conversation of officers that we have so far met, there is something of a reaction among them with regard to this matter of excessive speed in small ships. To attain a speed of twenty knots with a ship of two thousand or three thousand tons displacement, many important qualities must be sacrificed. Speed is certainly of great importance, but it may be bought too dearly; and the officers of the '*Forbin*' seem to feel that it has been bought too dearly in the case of their ship. Our own '*Baltimore*' has equaled the record of the '*Forbin*,' but she is large enough to attain a high speed without the sacrifice of structural strength, of comfort for personnel or of battery power. —*Unknown Exchange.*

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THE manufacture of emery is simple. The ore is broken in the ordinary stone crusher, then still further reduced in size by being passed through rolls or under a stamp mill, and then assorted by being sifted through wire cloth. When ready for market it is numbered according to the mesh of the wire cloth through which it has passed. To be clean, free from fine dust, and uniform in size, are the principal things to be desired. The coarsest emery is that which goes through a wire cloth of five meshes to the inch, and the finest numbered emery is 160. It is also used in fine flour.

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PERSONS who think that engineers are hard men, devoid of the finer feelings of human nature, should read some of the letters received condoling with us upon our loss. These letters are full of the warmest and kindest expressions of sympathy, and are highly prized. A member of our family has compiled all these under one cover and they are carefully preserved.

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AT the Kilbowie (Scotland) Sewing Machine Works, the young women work in their bare feet. The machines are not as well made as the American article.—*Ex.*

On account of the bare feet?

NO. 1, M. E. B. A., BUFFALO, N. Y.

THE brothers of this association recently had the benefit of a short address from John Cook, an expert boiler-maker of that city, and writer of the articles on Boiler Making in THE ENGINEER. Mr. Cook said:

Coming before you, a stranger to most present, I can hardly do myself justice, seeing that I have never addressed an audience before. Although a member of several other societies, I never had the cheek to even address them, so I hope you will have a little compassion on me. Not being blessed with the "gift of gab," I have to refer to notes, so that I don't get rattled at the first go-off.

I suppose there are a good many of you who, though prompt in action in the engine room, would not like to stand on a platform to be looked at and criticised, and as this is my first essay, that you will not try to rattle me in my endeavor to instruct. Now, as everyone wants information, and none are too old to learn, the idea of getting up meetings like this one is, I think is a good one, and would benefit a good many. My text will be on

BOILER CONSTRUCTION.

Advantage is usually taken of the self-supporting properties of the cylinder, which enables a boiler to be made sufficiently self-supporting without the aid of ties or other supports, that is, on the circular part. The force tending to rupture the cylinder longitudinally is represented by multiplying the diameter by the pressure on each unit of surface; as this applies only to a cylinder or a unit's length, it is evident that the total amount of force tending to divide the cylinder in lines parallel to its axis is joined by multiplying the aforesaid product by the length of the cylinder.

The retaining force opposed to the pressure is, evidently, the resistance of the material, at the two opposite sides which bear the strain; the strength of the cylinder to resist transverse pressure is, therefore, proportionate to the thickness, and is represented by the tenacity or tensile strength of the material multiplied by the section on both sides, or twice the thickness of material multiplied by the length.

In calculating the strength it is usual to consider the length as unity. The correctness of this is shown in the extra pressure due to increased length being balanced by a proportionate increase of material.

To find the bursting pressure of a wrought-iron or steel cylinder, the rule is to multiply the strength of the material in pounds per square inch, by twice the thickness of the material in inches, and divide the product by the diameter of boiler in inches; the quotient is the bursting pressure.

Supposing we have a shell or drum, 36″ diameter, made of $\frac{3}{8}$th steel of 60,000 tensile strength; then twice $\frac{3}{8}$ths equals $\frac{3}{4}$, and the decimal fraction of $\frac{3}{4}$ is .75, then the sum would read

```
      60,000
         .75
      ------
      300000
     420000
    --------
36)45,000.00(1,250
   36
   --
    90
    72
    --
    180
    180
    ---
      0
```

Here, then, are 1250 pounds as the bursting pressure, but this supposes that the joints are as strong as the solid plate. By all the tests the single riveted joint is but 56 per cent. of the solid plate, double riveted joints from 70 to 75 per cent. Supposing this shell was single riveted, it would only leave us 56 per cent. of the 1250 pounds which would reduce it considerably, for 56 per cent. of 1250 would leave only 550 pounds as the bursting pressure; which knocks theory higher then a kite, and there are or have been cases where boilers have exploded with 75 pounds and 3 gauges of water! Did you ever hear tell of a boiler which had exploded that carried more?

Now for the safe working pressure multiply the thickness of plate in inches by one sixth of the tensile strength of the metal, and divide the product by the radius, or half diameter of the shell, the quotient is the safe working pressure. Now the shell is 36″ diameter and 60,000 pounds t.s. by $\frac{3}{8}$ths thick. The process then is to take one sixth of 60,000, 10,000, which multiplied 375=3,750,000; divide this by 18 and it =208+. That is, if the heads were well braced. There are a great many things to consider in boiler making if the thing is worked up right. In a 36″ head there are 1,017.8784 square inches of area; this multiplied by 208 gives us 211,718.7072 pounds pressing against the head. Now supposing this shell is 72″ long, we would have to multiply 211,718.7072×72 and we see at once what an enormous pressure there would be in that small receptical. Is there any wonder about so many explosions occurring among "dollar-a-day" engineers? I think not, when most of them don't know what a magazine of destruction they are handling. You may have heard (I have seen them) of pine and iron wedges driven in the slot to keep the lever of the safety valve down, and no gauge on the boiler. To get a boiler head equal in strength to the shell we must multiply the square root of the radius of shell by the thickness, the product will be the thickness of the head. Here the radius is 18 inches, the square root of 18 is 4.24; then 4.24×375=1.59″ or a little more then $1\frac{1}{2}''$ thick.

This thickness is never used in a boiler of that size, so we must, perforce, brace it to stand the pressure. In all text-books 6,000 pounds is the highest allowed to the square inch sectional area of braces, so to find how many braces we need, multiply the area of head by the pressure to be carried, and divide by 6,000, which will give the number of braces. As there are 1,017.87 square inches of area in a 36″ head and the pressure is 150 pounds, then 1,017.87×150=152,680.50÷6,000=26 nearly. We can't get 26 braces in, but we can reinforce the head by putting stiffening plates in, if the fire did not come in contact with it, but if the fire impinged on the head we would have to use heavier braces, attached to the heads by four-footed crow feet. These crow feet can be made to span any distance. Or we could brace by stay-rods tapped into heads and riveted over. The plates of a boiler must be proportioned and stayed, not only with regard to strength, but sufficient stiffness must be given them to prevent change of shape under pressure. A change of shape in one direction by pressure and returning again to its original shape sooner or later results in a crack. The same is true, also, when braces are attached in such a way that the sheet is drawn from its true position.

ELECTRIC WELDING.

A FEW weeks since a naval board was ordered by the Secretary of the Navy to convene at Boston for the purpose of reporting upon the advisability of generally adopting the Thomson electric welding process, with the view to using the machines of this company in the various navy yards, and on board the government cruisers, etc. This board met in Boston, and after several days' careful investigation made a unanimous report recommending the use of the machines by the navy in its various departments. In this report they state:

We are convinced that the Thomson welding process can be found of great utility to the naval service, both on shore and afloat, for the following reasons: It can be used—

(*a*) In welding breaks in rods without altering them, either in length or shape.

(*b*) For welding tubes.

(*c*) For welding angles and shapes of intricate form.

(*d*) For welding copper, brass, cast-iron, or other metals.

(*e*) For heating metals for forging, tempering and upsetting.

(*f*) For welding wire cables.

Under these heads the following may be mentioned as a few of the many applications that would result on shipboard: For welding broken pump piston rods, valve stems, etc,; for joining wires of iron, copper, or other metals or bars of the same, of similar or different shapes or sections; for making joints at angles with bars (T or Y joints); for mending chain and wire rope; for constructing or joining, end to end, pipe of all kinds, and of large or small diameter; working or joining lead pipe; welding T connections or elbows into lines of piping; welding safe ends to boiler tubes; repairing boiler tubes; welding eye-rings, and welding these again to bolts or bars; repairing, cutting and boring tools without hurting their temper; lengthening or shortening rods or bars; repairing broken cast-iron pieces of machinery or broken cast-iron or cast-brass fittings; welding copper electric mains. The system of welding thus renders easy many operations in the working of metals which with the forge and smith have heretofore been considered impossible. It is the unanimous opinion of the board that in the present day of ships constructed almost entirely of metals, and in which every fitting possible is made of metal, such a system as that which has been investigated by us becomes not only desirable, but a means to economy of expense, time, and labor, and would add to the efficiency of the vessel under any condition of service. This system of welding occupies a position of its own; it is able to do not only a large part of the work of the forge now in use, but is capable of doing much work that was hitherto considered impossible. By its use, the large accumulation of now almost worthless boiler tubes stored at the navy yards could be made fit for service; and the quantity of spare tubes and of many other stores now carried by ships could be reduced.

PERPETUAL MOTION.

EVERY few months it is announced in some paper that some genius has succeeded in inventing perpetual motion, but in every instance the announcement is accompanied with a statement that there is some slight alteration, or additional mechanism required to make it a success. The trial is only postponed for a few days until these alterations or additions are completed. But either from want of the necessary funds, or some other plausible excuse, the work is suspended and that is the last we ever hear of it. This is the history of all such inventions for the last fifty years, and the problem of perpetual motion is no nearer solved to-day than it was fifty years ago.

Inventors of perpetual motion, as well as those of other mysterious mechanical devices that will not permit of a fair investigation by the public, may be divided into two distinct classes: First, the mechanical fraud; and second, the mechanical visionary or crank, who cannot be classed as a mechanic in the general acceptation of the term. But with the mechanical fraud the case is quite different. He is generally a man of some mechanical ability and ingenuity, sufficiently acquainted with the laws of natural forces and of mechanics to know that such a thing as perpetual motion is an impossibility; consequently, instead of making perpetual motion his hobby, he will claim to have discovered some new and powerful force that has never yet been discovered or applied, that is destined to revolutionize the whole field of mechanical science. The mysterious combination of wheels, cranks and levers, together with other mechanical devices which he claims to be necessary in order to utilize this newly discovered force so very different from anything heretofore discovered is well calculated to mystify and deceive the public, especially those not well versed in mechanical science. As these men are usually good talkers, they go on by an abstruse course of reasoning to show that all that is required in order to bring the same before the public, and obtain a large fortune, is sufficient money to perfect it. Strange as it may appear, he generally succeeds, while at the same time he never intends it to be finished, for he well knows that there is nothing practical about it. But as long as he can succeed in pulling the wool over the eyes of his dupes, and can succeed in obtaining money to carry on the schemes, the most of which goes into his own pockets, or to find new ones who are willing to invest their money in such chimerical schemes, he will continue to grow and flourish like a green bay tree.—*C. R. Tompkins in American Miller.*

◆

ONE who knows says that the English syndicate business is being greatly overdone. He says: "The idiotic manner, in which, for the past year or two everybody has been crowding into all sorts of wildcat schemes in London is literally incredible. A very large proportion of these ventures have been engineered by American promoters, and millions of sterling of British money have been carried across the Atlantic as a consequence. Some of this, I dare say, has been well invested, but over and over again I have seen property floated on the market in the form of a limited-liability company for twice and thrice what every American knew to be its real value. American breweries have been put into capital for $1,000,000 without the slightest difficulty upon which it would have been very hard work indeed to raise $300,000 in New York. Nothing is clearer than that this carnival of fox and geese must come to an end soon, and a conservative American banker with whom I talked the other evening, predicts that it will be the most widespread and damaging crash London has experienced in a generation."

◆

SEVERAL railroads have from time to time stopped wiping their engines from motives of economy. We have always felt that this was a poor policy, but, from the results of recent inquiry, we must concede that there may be times when it can with temporary advantage be adopted. The engines always, of course, get very dirty and filthy looking when they are not wiped, but we are assured by one who was some time ago compelled to adopt this measure of economy, that the destruction to the machinery is not what might be anticipated. This gentleman is now wiping all his engines, but assures us that he would not hesitate under the same conditions that existed when he stopped wiping engines to again omit it.—*Master Mechanic.*

It is curious to note what absurdities mankind practice at times. Either the wiping of engines is needful and economical or it is not. If it is beneficial why omit it at one time and take it up at another?

◆

STRENGTH OF ROPES.—We find in an English journal a rule for the strength of ropes, more suitable than one we published some time since. It is as follows: Divide the square of the circumference in inches by five. This gives in English tons what a rope will sustain. The English ton being 2,240 pounds, the divisor for American tons of 2,000 pounds should be to 5 as 25 is to 28, or 4.47. For example a rope 6 inches in diameter:

$$\frac{6\times6}{4.47} = 805 \text{ American tons}$$

for a rope 2 inches diameter or 6 inches circumference.—*Industry.*

◆

THE number of gondoliers at Venice has been much diminished since the introduction of steam launches in the canals, which form its thoroughfares. The few gondoliers left in service, however, are not complaining, as they receive better wages, through lack of competition in their own special line, and their sculling is much in demand by visitors.

TRADE NOTES.

C. B. Hanscom, a well-known naval constructor, is now at the Bath Iron Works, Bath, Me.

⁂

Chas. H. Haswell, the well-known constructing engineer, resigned his position as advisory engineer of the Department of Charities and Corrections in this city on the first of March.

⁂

E. Platt Stratton, well known as a mechanical engineer and marine surveyor, and formerly inspector of boilers in the marine service in this city, is now in charge of the iron and steel department of the American Shipmasters' Association.

⁂

C. L. Seabury & Co., Nyack, N. Y., have several steam yachts in course of construction, to which they are applying the Seabury Water Tube boiler. One of the yachts is for D. A. Loring, N. Y., and is 75′×11½′×3½″ draught. They are also building two launches, 22′ and 35′ long.

⁂

The Mechanical Engineers' Library Association has been incorporated. It proposes to maintain a free public library. Among the incorporators are Stephen Wilcox, Charles H. Loring, Frederic R. Hutton, Horace See, F. Merriam Wheeler, and Stephen W. Baldwin, all well known engineers.

⁂

A very complete account of the Forth bridge, that great monument of English engineering, is furnished in the Industries Forth bridge Special, a magazine of 120 pages in full detail, which has been written by the members of the engineers' staff, and must, therefore, be correct. It can be had of the International News Co., 83 Duane Street, N.Y.

⁂

It is stated on good authority that powder experts in this city have succeeded in compressing black power to give, on explosion, a muzzle velocity equal to the best results obtained from the Lebel powder. The experts are among the best-known powder men in the United States. The compression has increased the muzzle velocity of a projectile using the best grade of black powder from 1,400 feet per second to over 2,190 feet per second.

⁂

An American manufacturer who has been in London for some time investigating heating methods in use there, says that "hot water is used much more, as compared with steam, than here, at least ninety per cent. being hot water. Steam pipe is much dearer there than here. The mechanical construction is far behind American pratice. Pipes instead of being coupled with screw threads are caulked with yarn and red lead, and no unions or right and left threads are used. Improved heating plants are few in number, and steam is rarely used, hot water being the rule. The Metropole hotel, the largest and finest in London and probably in Europe, is entirely heated by open coal fires. Taken altogether, house heating in England as an art is in a very backward condition."

⁂

In this country newspaper men too often have to run after the advertisers instead of the advertisers running after them. Not so in England There the question of the utility of advertising is past the point of argument. It is only a question of mediums and methods and whether the advertiser can get the space that he wants. In the counting-rooms of the great dailies and of such periodicals as *Punch, The Graphic, The Queen, The Field, etc.*, there is a sublime air of "take it or leave it" on the part of the men behind the counter. Some papers so rigidly limit the space given to advertisers that one must wait weeks or months for the appearance of his announcement, and then, perhaps, accept a half less room than he asks. Some have one method and some another, but all manage to keep before the public and have themselves talked about. In turn, their own advertising spaces are in great demand, at prices which are high compared with the low rates ruling on this side of the Atlantic. The proportion of advertisements to pure reading matter in the great American newspapers is smaller, but with us it is not always easy, even for the expert eye, to tell the one from the other.

⁂

It is learned that the Illinois Steel Works, of Chicago, will attempt to secure the Government work on vessels intended for the great lakes. This firm is the consolidation of heavy steel and iron interests formerly situated at Chicago, Milwaukee, Joliet, Cleveland, and Buffalo. It is said that the consolidation of these iron and steel industries has resulted in the formation of a company with a capital of $25,000,000. It is further expected that all future cruising vessels authorized of 1,000 tons or thereabouts, will be bid for by the new steel works —in fact, any vessel of a draught and beam not too large to prevent her being taken through the canal. The transfer of the Revenue marine to the navy will necessitate the building of four cruising gunboats for the lakes, provided vessels are to be used in revenue marine duty capable of efficient service in time of war. In all likelihood, it is said, the Illinois Steel Works will secure the construction of these new gunboats. No opposition can be made to the building of warships on the lakes by virtue of any treaty with Great Britain, since the provisions of the last treaty expressly state that six months' notice is sufficient to make the same null and void.

⁂

Engineers contend that so far no boiler has been produced in this country that will stand salt water, and hence be serviceable for warship purposes. It has been stated incontestably that the Ward boiler cannot use salt water. The defects in the Ward boiler are not considered irremediable, and Chief Engineer Loring is of the opinion that the introduction of an inner tube might possibly assist in forcing the circulation. So far the only tubulous boiler known to have worked satisfactorily is the French Belleville boiler. As high as 32,000 indicated horse-power is at present being operated by these Belleville generators in the French Navy, and during the year 1890 16,000 additional horse-power will be added. No less than 8,000 indicated horse-power is being developed in one ship alone by these boilers. The French Government test on all Belleville boilers is a six weeks' continuous run, using salt water exclusively, and conclusive evidence after the test that no perceptible damage has been wrought. '*L'Ortegal*,' a French steamer of 1,600 horse-power, has been running from Bordeaux to the River Plate during the past six years and using the Belleville boiler exclusively. During the six years not a single breakdown of note has been recorded against the boilers. The engineers of '*L'Ortegal*' report that in comparison with Scotch boilers the Belleville boilers are no better, provided the Scotch boilers when brought into comparison are perfectly clean, but that the Belleville boilers present the advantage of being more readily kept clean. and that steam can be obtained and maintained more readily than in a Scotch boiler.

⁂

By a recent decision of Judge Dykman in the Supreme Court in White Plains, N. Y., C. H. Delamater & Co. finds itself in possession of $105,700 in mortgages which are declared to be worthless. Joseph Colwell, of the firm of S. S. Hepworth & Co., Yonkers, died in 1882, leaving property in the hands of three trustees, of whom George H. Robinson was one. The firm failed in 1887. Before the failure the Colwell trustees had lent the firm $95,000 and taken a chattel mortgage on machinery. Mr. Robinson neglected to record the mortgages. Soon afterward Mr. Robinson, acting not as one of the Colwell executors, but as a partner of C. H. Delamater & Co., endorsed his firm's name to S. S. Hepworth & Co.'s notes, aggregating $105,700. These notes were made to Samuel A. Briggs, an employee of the Delamater Company. Mr. Robinson also employed him as bookkeeper in the Colwell estate. S. S. Hepworth & Co. gave Briggs a chattel mortgage to secure the notes. Briggs knew of the chattel mortgages given by the firm to the Colwell estate. When S. S. Hepworth & Co. failed they assigned to S. Francis Quick. Their assets amounted to $99,000. In the contest that arose to determine which of the two sets of chattel mortgages given by the firm was binding, the Delamater mortgage was thrown out. The Delamater firm asserted that though the Colwell mortgages were prior, they were hopelessly ignorant of their existence, since they had never been recorded. It was shown, however, that both Mr. Robinson and Mr. Briggs knew of their existence at the time the loans were made to the Delamater firm. Mr. Robinson has since ceased to be either a partner in the Delamater firm or an executor in the Colwell estate.

THE ENGINEER.

[We do not publish verses as a rule; but to oblige some brothers in Florida we have done so at their request, they forwarding the copy.—Eds. Engineer.]

How greatly an engineer resembles his trade !
Both being so "fearfully and wonderfully made,"
Brave, frank, open-hearted, and manly; no fear,
Be he "high" or "low pressure," of a good engineer.
Like their "engines" 'tis likely they all have their faults;
But what "class" are "*perfect*" 'neath heaven's blue vaults?
Some work "non-condensing," while others "condense;"
Some work by "expansion;" *all* use common sense.

Some, "carry high pressure," and, as "boilers" oft do,
"Or by too heavy pressure" collapsing a "flue."
No matter what "tests," or "how heavy their load,"
Be it said to their credit they seldom "explode,"
Though some (though all our fraternity don't)
Will "go on a bust" when their "boilers" just won't.
At abuse he'll "fire up," and "foam," "prime," and "cough":
Just speak to him rudely and see him "blow off."

He's mostly "in line" and correctly "upright,"
Though "eccentric" full oft, and a "crank" at first sight.
His visage is truth's "indicator," a "gauge,"
In his "clear," even "fires" in his furnace that rage;
Energetic and pushing, symmetric in "beam,"
He, like a good "valve," works at "full head" of steam.
On his "guides" he "works smooth" with no "knocking around."
In good men and "engines," slight "friction," less "sound."
Sometimes they've a "cross-head," "tee-head," if you will;
But then they must have them "good work to fulfill."
When you meet this same "cross-head," look out for "loud knocks,"
If he's "out of line" badly, or has a "hot box."
And, brothers, some of us are "rotary," you know,
Some "run at high speed," while the others "run slow;"
Still, we've a good "check-valve," our conscience, you see,
Keep it well "lubricated," not "gummed up," but "free."

Have never a "screw loose," nor charity lacking;
Keep clear of the "hump," save to use it as "packing."
Our "safety-valve" let fidelity be
With "area" large, on its "seat" "working free."
Your "boiler" keep "full," but don't get "full" yourself,
For when one gets "full" he'll be "laid on the shelf."
Keep your life and your "boilers" of "mud" and "scale" clean,
Shun "compounds," "corrosive," rum, whiskey and gin.

The "poker" to "draw" "fires," on this lay great stress,
"*Draw*-poker," however's a "great bar" to success.
Be honor your "governor," not alone "automatic,"
Quite "sensitive" be it, not too aristocratic.
Practice "full economy;" keep "everything "bright;"
Have a "*man*-head;" keep sober, but keep your "keys" tight.
In life's race "run forward;" on each "lap" try to "lead;"
"Run steady," "exhausting" all means for "full speed."

When your "license runs out," to your "doctor' you flee,
And death's point of "cut-off" you plainly can see;
And, done with life's "labor," absolved from all cares,
May our tombstones bear record, "Laid up for repairs."

—*Henry J. Pate, in Wood and Iron.*

CLUB RATES FOR 1890.

In former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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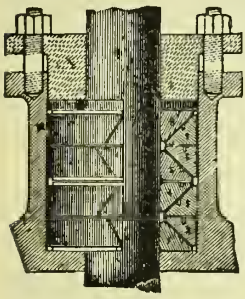

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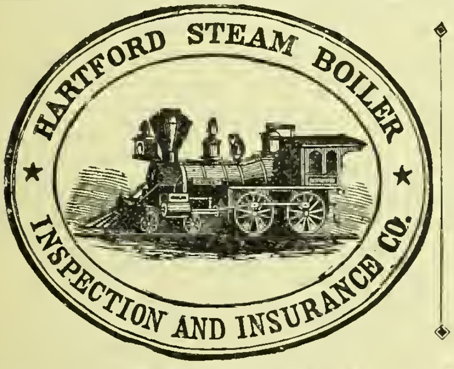

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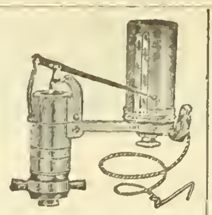

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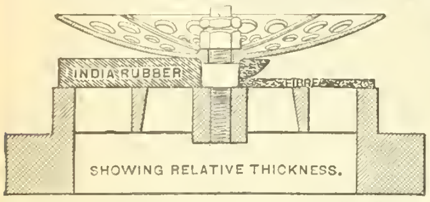

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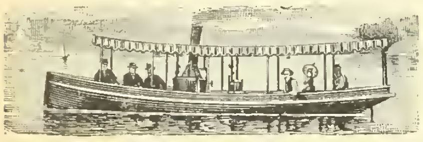

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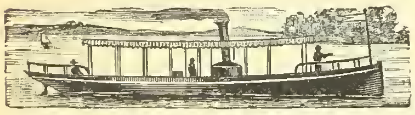

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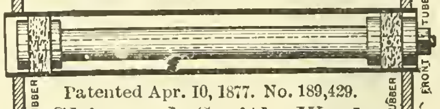

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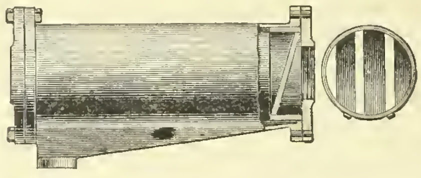

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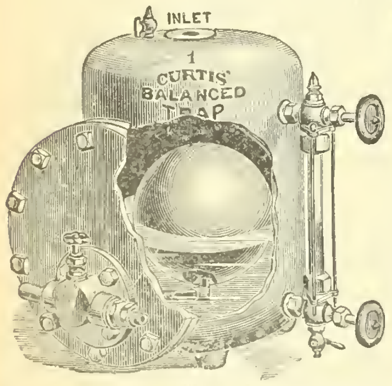

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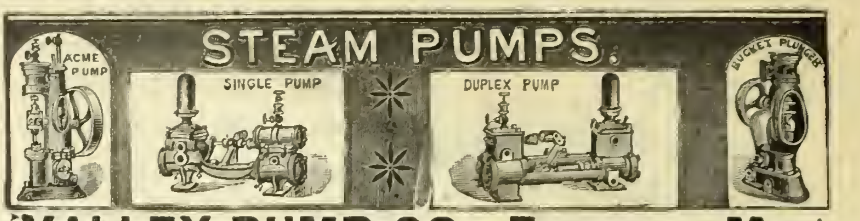

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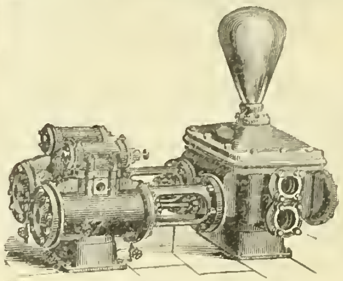

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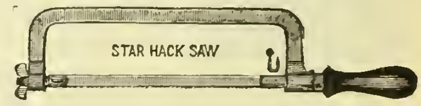

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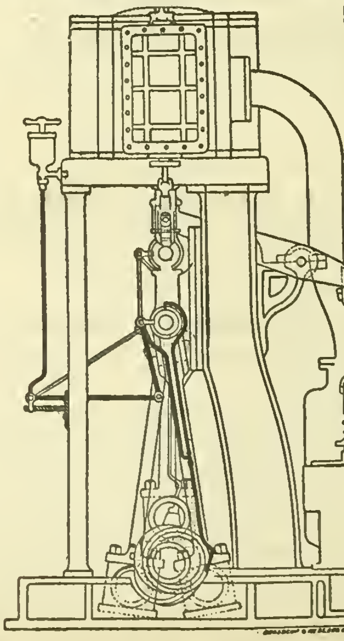

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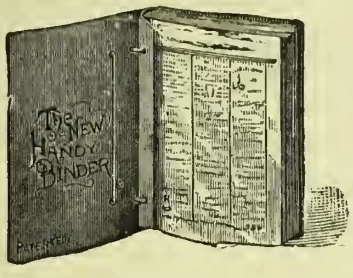

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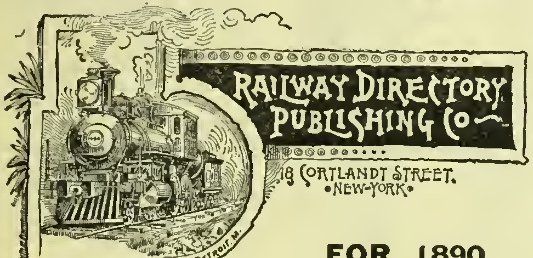
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GENTLEMEN:—For the past two months I have been using your Lubricating Balls upon our steamer "Rosedale," and we have been making 131 miles per day, using but two of them each day, and **I can say that in all of my forty years' experience have never found its equal as a cylinder lubricator.** Yours very truly,
HENRY LAWRENCE, Chief Engineer People's Line.

OLD DOMINION STEAMSHIP COMPANY.
NEW YORK, May 1st, 1883.

GENTS:—In answer to your inquiry as to how I liked your Lubricating Balls for lubricating the valves and cylinders of our compound and other engines, I am pleased to say, after a trial of five months on the Steamship "Roanoke," and two months each of the Steamships "Guyandotte," "Breakwater," and "Richmond," that it has given entire satisfaction. We use two Balls an hour in the large engines, developing 1,400 horse power, and one Ball per hour in the small engines, developing 500 horse power. We find the valve and cylinder surfaces wearing much smoother and the friction greatly reduced. The surface condensers and boilers are entirely free from the filthy grease that collected in them when we used Cylinder Oil. I take great pleasure in recommending your Lubricating Balls to all parties who want a good lubricator for their valves and cylinders without having the filthy grease collect in their condensers and boilers. Very respectfully, GEORGE Y. SLOAT,
Supt. Engineer Old Dominion Steamship Co.,
Pier 26 (New No.), North River.

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GENTLEMEN:—In reference to your Patent Lubricating Balls, I have used them on board the steam Yacht "Stranger," and found them to be all you claimed for them. I have used the best cylinder oils in the market, but owing to the steam being superheated at 5 lbs. pressure, I had a good deal of trouble to keep the valve face in order till I commenced to use the Balls, after which I had no further use for oil, and also my boilers are free from grease and dirt, and I may state they are cheaper than oil in direct cost. I take pleasure in recommending them to any person requiring a good internal lubricant. Yours truly,
JOHN REDMOND,
NEW YORK, Dec. 20th, 1886. Chief Engineer Steam Yacht "Stranger."

These are only a few out of many similar which we shall be pleased to send on application.
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I find the wearing surfaces of the valve and cylinder very much improved, consequently the friction must be and is greatly reduced.

The first month I used two balls per hour, I gradually reduced the expenditure to one ball per hour.

They work equally as well, and I am using them in the cylinder of the circulating engine running at high speed.

[illegible] continue the use of your Lubricating Balls, because I have found them to be superior to any lubricant I have used in the cylinder, so the most economical.

I will also state the condition of the boiler now is so much improved that it is a pleasure for me to go in it, while such was not the case before I used your Lubricating Balls; consequently, they are all you claim for them.

Very respectfully,
M. T. CHEVERS,
Chief Engineer, U. S. R. M.

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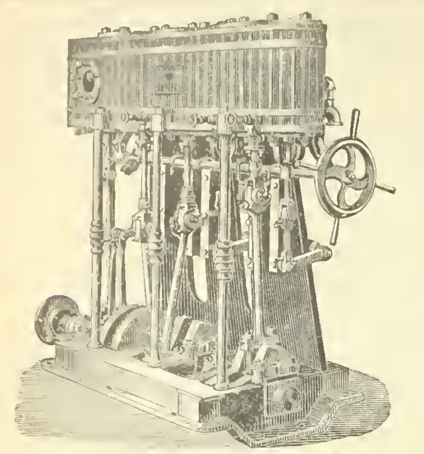

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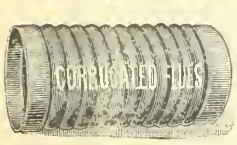

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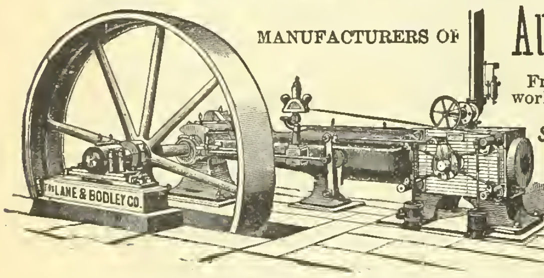

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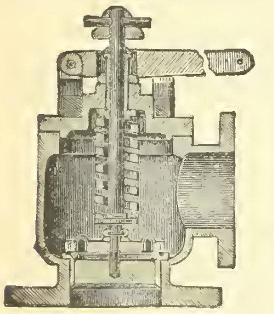

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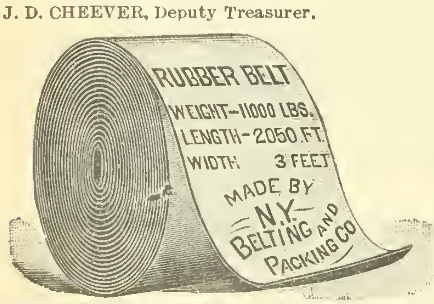

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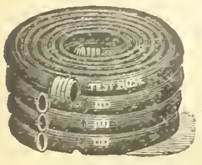

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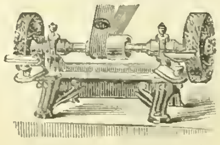

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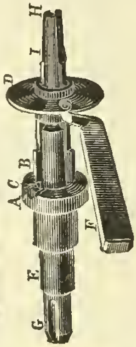

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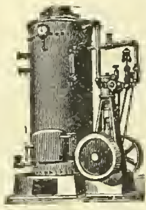

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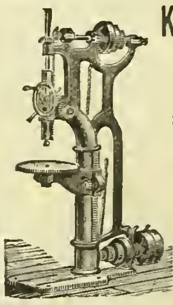

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NEW SERIES, 1883, 1888. VOL. XIX. No. 7
TENTH YEAR OF PUBLICATION.
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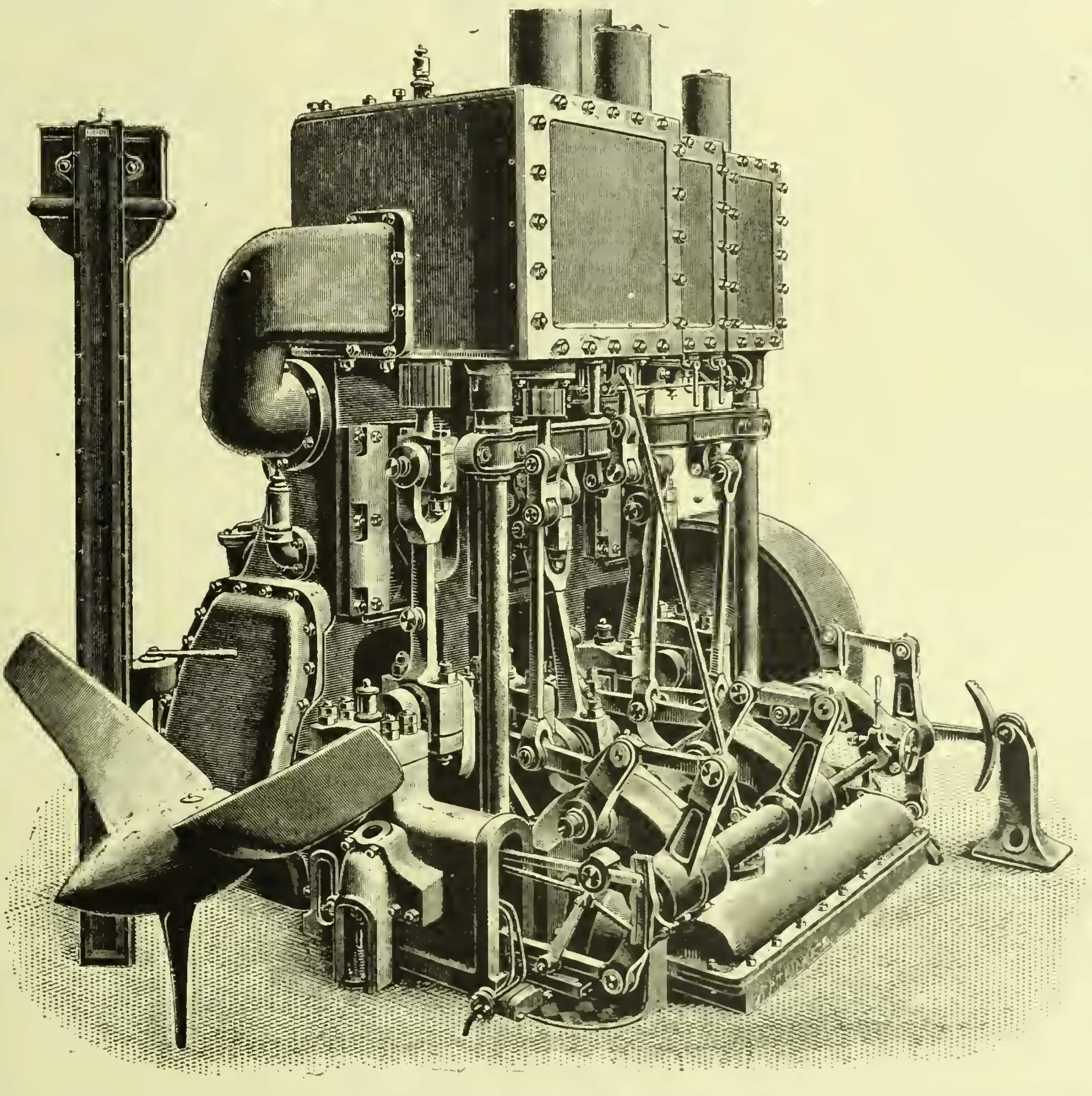
$2.00 PER ANNUM. - SINGLE COPIES, 8 CENTS.
March 29, 1890.
MECHANICS, AND THE ALLIED ARTS.

FRENCH TRIPLE-CYLINDER EXPANSION ENGINES.

IT is not very often that we have an opportunity to see the work of French marine engine builders, but one is afforded us in the engraving herewith taken from *Engineering*. We think most American engineers will agree with our view of them, which is, that in so far as the design and the valve gear employed goes, these engines are very inconvenient, to put the matter mildly. We allude particularly to the great extension in front to accomodate the valve gear. This renders it impossible for an engineer to get anywhere near the intermediate engine when at work, and difficult, but not impossible, to reach the h.p. and l.p. engines. To our mind these are fatal objections to any sort of valve gear, not at all compensated for by any virtues arising from its other good qualities. This gear is Solm's, and it is a perfectly bewildering mass of joints, levers, cranks and balances. It is a radial gear and a costly one to make and keep up, and the clanking, which must inevitably occur from the multitudinous joints in it, would drive a good mechanic wild in a short time. It is utterly impossible to keep so many joints velvet - smooth and iron and iron; when they are not in this condition they will talk out loud. For a set of engines that cannot be got at when running, these are pre-eminent.



The cylinders are carried at the front by a pair of columns, and at the back by three standards, of which one—that at the end corresponding to the high-pressure cylinder—forms the hot-well, while that in the center forms a reservoir of water at high pressure by which the *servo-moteurs* (to be hereafter referred to) are worked, and that at the other end forms a connection between the low-pressure cylinder and the condenser, and is also fitted with an injection pipe so that it forms an injection condenser for use if necessary.

A special feature in this set of engines is the arrangement of the governing and reversing gear. This gear is actuated by two of M. Farcot's *servo moteurs*, one operating the gear of the high-pressure cylinder, and the other the gears of the intermediate and low-pressure cylinders. M. Farcot's *servo-moteurs* in this case consist of hydraulic cylinders having their valve gear so arranged that (as in the case of other steam and hydraulic reversing gears) the main piston follows the motion of a lever moved by hand or by the governor. The governor, in this instance, consists of a cylinder fitted with a piston, the underside of which is exposed to the pressure of a column of water (or if preferred to the pressure of a spring), while the upper side receives the pressure of water delivered by a small centrifugal pump driven by the engines, the water so delivered being discharged through an orifice which is adjustable. Thus an increase or decrease in speed of the engine causes an increase or decrease in the speed of the pump, and a corresponding movement in the piston of the governor. This movement of the governor piston in its turn, acts on the controlling valves of the two *servo-moteurs*, and causes them to operate on the valve gear, decreasing or increasing the period of admission as may be desired. The arrangement is such that for small variations of speed the *servo-moteur*, belonging to the high-pressure gear alone, comes into action, the gear of the intermediate and low-pressure cylinders being only altered when considerable change has been made in the ratio of expansion in the high-pressure cylinder. The arrangement of the valve gear, we may add, is such that the point of cut-off in the high-pressure cylinder can be varied from zero to eight-tenths of the stroke.

It will be noticed from the engraving that the reversing levers for the intermediate and low-pressure gears are mounted on a hollow shaft through which passes a shaft carrying the starting lever and the levers by which the *servo-moteurs* are controlled. The starting lever is shown towards the right-hand end of this shaft in the engraving, its position being limited by two nuts on a right and left-hand screw actuated by the handwheel there shown. To start the engine the screw is turned so as to separate the nuts, and the starting lever can then be pushed over in either direction according to whether the engine is to move ahead or astern. To stop the engine the screw is turned so as to bring the nuts together, thus returning the lever to its central position.

◆

"THE picture is in the eye of the beholder," says the adage, meaning that if a man sees beauty in a picture it is owing, in a sense, to his artistic perceptions and ability to do so This is quite true of a portrait. Some persons are utterly unable to discover a likeness in a good photograph. This is not the fault of the picture, but is owing to a peculiarity of vision, whereby the printed image looks differently to the observer than the actual face. There are defects in mental processes also, whereby men see things or misunderstand accepted facts and attempt to explain them to others upon the basis of their misunderstanding. Men do not willfully misinterpret natural laws, but they most wofully misunderstand and pervert them sometimes. This seems to us to be owing to obliquity of mental vision, whereby a distorted image is projected on the brain and reflected therefrom to others.

◆

THIS may come handy in dealing with drunken firemen—if you can get them to take it: Half a teaspoonful of chloride of ammonium in a goblet of water will almost immediately restore his faculties and powers of locomtion to a man who is helplessly intoxicated. A wineglassful of strong vinegar will have the same effect, and is frequently resorted to by drunken soldiers to enable them to return steadily to their barracks.

BOILER MAKING. No. 36.

By John Cook.

These diagrams are merely to show how the tubes and braces are placed in a horizontal tubular boiler. Fig. 1 is a diagram of a 36″ head for what is termed a 15 h.p. boiler. It contains 28 tubes, 3″ diam., 8′ long. There are five braces in each head; two short ones and three long ones. The short ones are at the top, or on the arc; the lines with the numerals on are to show where the braces will strike the shell; 2 and 4 are on the arc. I draw a line from center of head through center of brace to shell, as in Fig. 1, which will be $6\frac{1}{2}''$ from top center of sheet to center of brace-holes in shell for the short braces I then draw a line a given distance from top of tubes for lower or long braces. As in this case there will be three, one in the center and one each side, I lay the square on the line, and, with the corner on the point marked for center of brace, draw the lines 1 and 5 giving the other centers. Fig. 2 shows about where the braces will be on the shell when in place. The material for this boiler to be made in two courses will be as follows for double riveted horizontal seams, outside measurement: 1 sheet, (C. H. No. 1 shell) $115\frac{3}{4}'' \times 54\frac{1}{2}''$, ten pounds to square foot, 1 sheet, $114\frac{1}{4}'' \times 54\frac{1}{2}''$, same weight; 1 sheet (flange) $57\frac{3}{4}'' \times 22''$, same weight; 2 heads, $39\frac{1}{2}$ diam., 15 lbs. to square foot; 1 sheet, $21\frac{1}{2}''$ diam., $12\frac{1}{4}$ lbs. to square foot; 28 tubes, 3″ diam. × 8″ long; 440 rivets, $\frac{5}{8}'' \times 1\frac{1}{2}''$; 36 rivets, $\frac{5}{8}'' \times 1\frac{3}{4}''$; 21 feet of $2'' \times \frac{1}{2}''$ bar iron: 33 feet of $\frac{7}{8}$ round iron.

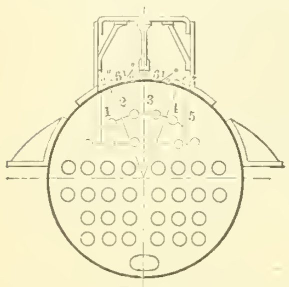


Fig. I

The approximate weight will be as follows: Shell sheets, 870 lbs.; 2 heads, $255\frac{1}{2}$ lbs.; dome sheet, $88\frac{1}{2}$ lbs; dome head, $37\frac{1}{2}$ lbs.; rivets, 118 lbs; 21 feet of $2'' \times \frac{1}{2}''$ bar iron, 71 lbs.; 33 feet of $\frac{7}{8}''$ round iron, 67 lbs; weight of tubes, 980 lbs. These weights are only approximate or calculating at ten pounds to square foot for $\frac{1}{4}$ iron. As some build these boilers in taper courses, I will give the plan I used for ordering iron for such boilers:

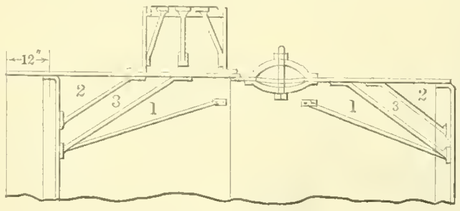


Fig. 2

Material for boiler $36'' \times 8'$ with 12″ shell extension, single riveted all through. No. 2: 1 sheet $114\frac{1}{4}'' \times 54\frac{1}{2}'' \times$ ten pounds (60,000 F. S. steel) to square foot; weight 8.77 pounds; 1 sheet $114\frac{1}{4}'' \times 54\frac{1}{2}'' \times 10$ lbs. (60,000 F. S. steel) to square foot. The heads, dome sheet, etc., will be as in the other plan. By marking the sketch plate in figures they are not liable to make mistakes at the mill in cutting the iron or steel. The material for a $36'' \times 8'$ boiler, flush end, that is, one without an extension, or for a full front, would be for single riveting taper course. No. 3: 1 sheet, $114\frac{1}{4}'' \times 47\frac{1}{2}'' \times 50{,}000$, T. S. C. H. No. 1 iron, 10 lbs. to square foot; 1 sheet $114\frac{1}{4}'' \times 47\frac{1}{2}'' \times 10$ lbs. to square foot, square with heads, dome sheet, etc., same as the foregoing.

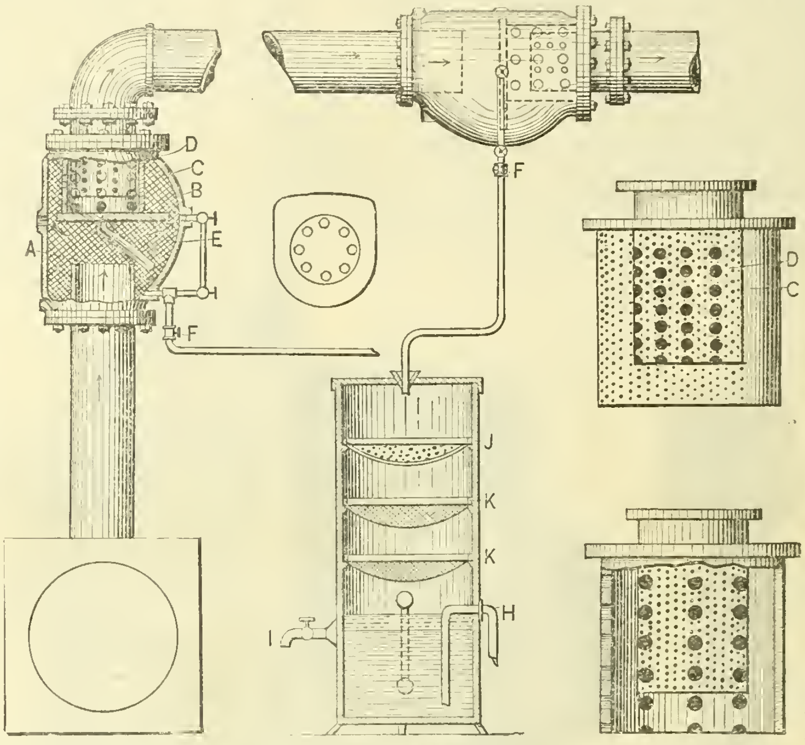
The weights of these for shell sheets would be only 755 pounds. In getting the time for making boilers No. 1 and 2, and there are 476 rivets in No. 1, it being double riveted in horizontal seams, and 380 rivets in No. 2, single riveted, for snap rivets I allow 300 per day's work for gang of four men and boy, and for calking 25 yards for a day's work. As there is but a little over 17 yards in the boiler to be calked, it can be done in one day. The tube sheet can be flanged in three hours easy with three men, and the dome and head in the same time; for flangeing I allow 18 hours. Summary: 6 days, riveting; 1 day, calking; $\frac{1}{2}$ day, tube setting; $\frac{3}{4}$ day, drilling; 1 day, punching; $\frac{1}{2}$ day, beveling; $\frac{3}{4}$ day, blacksmithing; $1\frac{3}{4}$ days, flangeing; $1\frac{3}{4}$ days, rolling and fitting up; $\frac{1}{2}$ day, testing. Total, $13\frac{3}{4}$ days for building a 15 h.p. boiler in the usual way.

* * *

ROBERTSON'S EXHAUST OIL-EXTRACTOR AND FILTER.

In heating mills, hotels and office buildings, as well as in manufacturing ice refrigerating machines, in dye houses, bleacheries, woollen and paper-mills, breweries, etc., exhaust steam plays an important part, and by utilizing the condensation the fullest economy can be obtained.

Probably one-half of the initial heat is retained in the exhaust on leaving the cylinder and condensed steam is the very best for boiler purposes, all the impurities in the water having been removed. A serious obstacle, however, exists in many cases which prevents the adoption of this system.



The oil used in the cylinders and on the rods for lubricating purposes, being carried out with the exhaust, adheres to the inner surfaces of pipes, radiators and valves, reducing their radiating capacity and necessitating an increased pressure of steam. Where the water of condensation is returned to the boiler, the oil is carried with it, doing serious injury to the entire system and causing the boiler to foam.

The Robertson Extractor shown here remedies this difficulty and the manufacturer offers it to the public with the fullest assurance that it will accomplish this object. Unlike other devices it is adapted to either vertical or horizontal pipes, and its operation is simple and effective.

Steam on entering inlet *A* strikes plate *B* and is deflected against the roughened sides of the extractor, depositing a considerable quantity of oil and water; when partially cleansed, the steam seeks an outlet through separators *C* and *D*, one within the other, and both perforated to suit existing conditions, care being taken to have the area of them larger than the inlet, and governed by the back pressure the engine or pump may be working under. These separators presenting a broad rough surface to the current of steam, again break it up, and complete the separation of oil and water which in horizontal extractors drop to the bottom, and in the vertical is carried to the side of the extractors by small pipe *E*, the cleansed steam passing away through the outlet. The effectiveness of a device for this purpose consists in offering as many obstacles and breaking up the steam, as much as possible, without creating back pressure, and the reader will see, that Robertson's Extractor includes these features thoroughly. There is no chance of this extractor becoming sealed by an accumulation of oil and water in the pocket, and choking up the outlet, as both the sides and top of separators are perforated, affording ample exit. Large area for expansion of steam is provided immediately on its entrance, and the roughened sides give fully three times the extracting ability of smooth surfaces.

It is generally acknowledged that lubricating and machinery oil loses but a trifle of its lubricating qualities in passing through the cylinders, consequently that portion passing out with the exhaust if recovered and passed through a filtering process, can be used over and over again, resulting in a great saving and soon returning the cost of the entire apparatus. The filter described, either in connection with the extractor or used separately, presents features of much merit while being exceedingly simple. The oil and water entering at the top, pass first through a finely perforated tray *J*, depositing the heaviest sediment and then through two filtering cloths *K*, *K* of different textures, completely cleansing it of every particle of grit and foreign matter. The siphon *H* carries off the water automatically, the oil being drawn off through cock 1, as often as the accumulation indicated in gauge-glass may require. The lid and filtering tray being loose makes it a very easy matter to clean.

A patent has been applied for on this device. Address Hine & Robertson, 45 Corrlandt Street, New York.

* * *

A very important amendment to the Steamboat Inspection Act has been made in the Canada Senate. Heretofore, while Canadians have been unable to go over to the United States and become engineers of vessels there unless they become naturalized citizens, there has been nothing to prevent Americans coming over here and acting as engineers on our boats, thus taking the bread out of Canadian's mouths. The labor organizations have sought a remedy for this grievance for some time past, but without success until now. When the bill was in committee the Hon. Mr. Abbott spoke of the disability under which Canadians labored in this respect, and secured the insertion of an amendment providing that no applicant for the post of steamboat engineer not a British subject shall be entitled to receive such certificate, unless he has been domiciled in Canada for three years, or shall have served as an engineer of a British vessel for that period. The proposal was calculated to induce American engineers to live in Canada.

[What nonsense this is! American engineers do not go to Canada for jobs, and do not live in Canada, either.]

SPECIAL NOTICE.

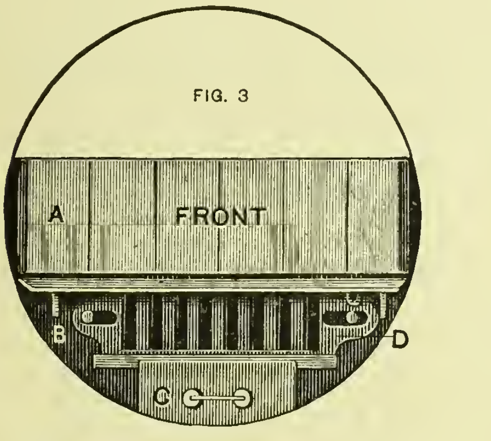
E. E. Roberts will lecture on water tube boilers before the Ocean Marine Engineers' Association, 169 Bowery, on Wednesday evening, April 2. The lecture will be illustrated by the stereoscopic views, and as the expense of them is borne by Mr. Roberts himself, we hope the brothers will see that he has a full house. No admission fee charged.

* * *

By an oversight in the make-up of last issue the series number was not changed outside. So there are two Number 5's in this volume. The date of issue is correct, which will prevent any error in binding volumes.

TUCKER'S PATENT BRIDGE WALL.

THE bridge wall of a steam boiler is a very important adjunct, and according to its proportions and setting so is the action of the boiler, or the evaporation of the water in it. From a mere partition at the end of the grate to keep the coal from being thrown over into the tubes or combustion chamber, it has been improved so as to exert an important function in the generation of steam. The patentee of this bridge wall, E. W. Tucker, has a correct idea of the influence of the bridge wall, and it occurred to him to make it on the plan here shown. This is briefly to make the wall double or hollow and surmount the opening between the two walls with a perforated iron plate, as shown at *A*, fig. 1. The air entering the ash pit passes under the grates and is thereby heated to a greater or less extent. On reaching the bridge wall, however, it is highly heated—after the boiler has been in operation awhile—and in that condition passes through the openings and is thoroughly mixed with the gases of combustion, with which the air unites, forming flame upon ignition. The volume of air for any given consumption per square foot of grate can be governed by the damper *D* in figs. 1 and 3. It is well known that if the temperature of the nascent gas is lowered after it is formed or given off from the fuel, that the whole volume of air and gas goes through the flues into the stack without being burned at all. This is, of course, direct loss, for the gas is one of the most valuable constituents. Mr. Tucker's bridge wall is said to fulfill all the assertions made for it, and it is now in use on a large number of steamers in California, where the inventor resides. From its construction and the principles involved we think his claims well founded. Address the inventor at Risdon Iron Works, San Francisco, Cal.



◆

AN American abroad says: "The first criticism I would pass upon the press of London would be for indirectness of speech. When a newspaper writer wishes to convey the idea that yesterday was a pleasant day he says: 'Yesterday was not an unpleasant day.' A good play is 'not half bad,' a humorous speech is 'not unrelieved by wit,' a riotously applauded address is 'not wholly unaccented by demonstrations of approval,' and so on. All this may be subtle, and it may be conservative, but it is not Anglo-Saxon."

[Well, if you go back to Anglo-Saxon, you will get some things that look badly in print.—EDS.]

◆

"A MAN who exercises, and is of nervous or irritable temperament, ought to be cautious as to the amount of work he does, because, calling too much on his will, nervous over excitability is likely to follow. You may work the phlegmatic man with less precautions than the one with an ardent temperament. In the latter case the danger is not only of exhausting the muscles, but of tiring the brain."

I AM a landsman. I have crossed the ocean, but my thought while on the ocean is, What a fool I am to leave my pleasant home for this eight by ten room, and feel like this! My sexton is not a landsman. He went to sea when he was a boy in his early teens. As a minister I occasionally indulge in figures drawn from the ship. I have made up my mind to stop this indulgence. Usually after the close of a sermon which has contained a nautical allusion, I ask my good sexton, "Was that all right?" He begins to laugh and say, "Bad as ever." "What," asked I on the last occasion, "doesn't a ship go under bare poles in a gale?" "No, you couldn't handle her if she were." "And don't you tie the sails to the masts?" "Tie the sails to the mast?" he said, "not a bit of it." I have therefore decided to stop my tendency to nautical metaphors, as I want to keep the respect of my sexton. I sometimes hear of my brother ministers who are given to be homiletic sailors. They usually beat about in the same latitude and longitude that I do. Some of them always get the ship into a storm; others have their attention directed to the life saving service, to the line shot from the shore, and tied to the mast; others are forever wrecking the ship on the reef of some temptation; others, yet more harrowing, are picturing the upturned faces and streaming hair on the yeasty waves. I always know whether they are going to land or to drown when they launch out.—*Unknown.*

FIG. 5

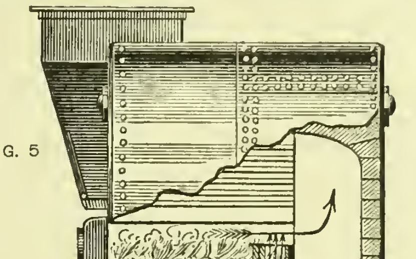


FIG. 2

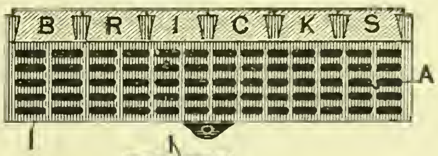
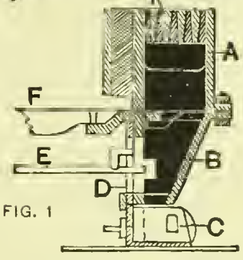


FIG. 1



◆

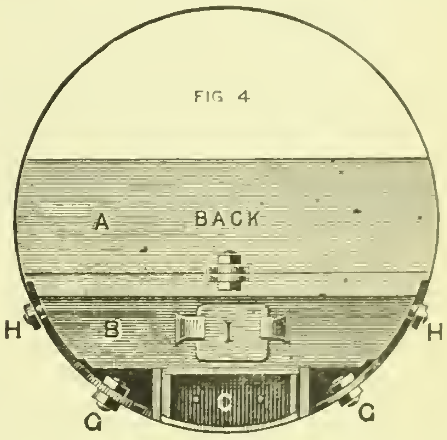
A VERY curious tale is told in *Engineering* with respect to a recent dispute in connection with one branch of the iron trades. A demand was made for increased pay for overtime by the day workers; the firm refused, unless the men worked the full fifty-four hours per week, after which increased rates would be paid. But many of the more skilled men worked by the piece, and they did not, as a rule, work more than four days per week, their plea being that the nature of the work was so exhausting that they were not able to stand more. When the matter was investigated it was found that these men crammed into the four days at full speed a whole week's usual work, at high rates of pay; but they kept their helpers unemployed during the first two days, and only paid them for four, so that while the higher paid got a full week at high rates for four days' work, the less paid and more laborious workers lost two days' work and wages in each week. Truly man's inhumanity to man makes countless myriads mourn. The Society intervened to minimize this inconvenience to the masters and injustice to fellow workmen.

WHEN the railroads of this country adopt a method of keeping accounts by which the supply department gets credit for supplying the best material, instead of the cheapest, their net receipts will be a good deal larger than they are now. If those who are responsible for the quality and quantity of the supplies of a railroad were required to make detailed reports covering a term of three or even five years it could be clearly seen whether or not they were profitable servants. —*Master Mechanic.*

Our contemporary would confer a great favor if it would give some method by which "the best" could be told at sight, in any given supply needed.

◆

"WE happened in a factory the other day and found the superintendent out in the yard with a melting ladle in his hand full of white powder. It looked not unlike whiting, but in reply to our query he told us that it was white lead, which he was about to test. As this test would be of interest to the rubber men, we lingered to see how it was done. The operation was exceedingly simple, and took but a short time. Having filled the ladle full of the white lead, he took an oil can and poured a little oil over the top of the mass, then placed the vessel in the fire and waited until the whole of its contents had fused. When he had run the powder down to pig lead again, he weighed it, and expressed his satisfaction at finding that he had exactly a pound, which had been the weight of the powder before it was melted." —*India Rubber World.*



[We express incredulity in this statement.]

◆

THE Secretary of the Navy has approved the report of the board of officers appointed to witness the tests of the dynamite guns of the cruiser '*Vesuvius.*' The report shows that three shots were fired from each of the three guns, the charge being about 204 pounds of gun cotton, which together with the structure of the shell and fuses and packing, made the total weights vary from 505 to 510½ pounds. The guns were elevated at an angle of 18 degrees. Each flight was steady, the distances varying from 2,116 to 2,333 yards. The report concludes: "The record shows that a shell containing 200 pounds of dynamite or other high explosive was thrown at least one mile by each of the dynamite guns constituting the vessel's armament. The ranges attained were considerably over the mile, being respectively 2,116, 2,233 and 2,333 yards."

◆

THE '*Cushing,*' a torpedo boat, has accomplished very satisfactory results. She went over the measured mile seven times in 2 minutes 49.4 seconds, 2 minutes 35.4 seconds, 2 minutes 45.2 seconds, 2 minutes 36.8 seconds, 2 minutes 41.9 seconds, 2 minutes 28.2 seconds and 2 minutes 37.2 seconds. As she had to turn eight times, her speed was necsssary lessened somewhat, but she will exceed the speed required of her by less than a quarter of a knot. Her average was 2 minutes 40.8 seconds a mile, which would be a speed of 22.4 miles an hour.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

CORROSION OF PROPELLER SHAFTS.

Editors ENGINEER:

In your last issue is noticed an example of corrosion of the propeller shaft of the '*Lofna*.' The particulars of a similar case were given and the great danger of such corrosion was pointed out in a paper by myself, presented to the American Society of Mechanical Engineers at their Philadelphia meeting in 1882, entitled "*Corrosion of the Propeller Shaft of the Ss. 'City of New York.'*" This shaft was $12\frac{3}{4}$ inches diameter, and the brass liner in the stern bearing was put on in three pieces. When the shaft was taken out, I found the joints between the liners open one-half of an inch, and the diameter of the shaft at those two places had been reduced $1\frac{1}{4}$ inches by corrosion in five years. Whether the liners had separated in use or were left apart by carelessness in shrinking them on the shaft, I do not know, but if the joints between them were made tight at first, they probably remained so for a time, and corrosion must then have progressed still more rapidly than one-fourth of an inch per year. The shaft between this liner and another through the packing-box, a distance of 14 feet and uncovered, was very uneven, having hollow spots more or less deep, and perhaps an average of one-half an inch had been eaten from the surface. I think this is an important matter, for the corrosion of propeller shafts is certainly very dangerous and should be prevented in some way. The shaft should be covered water tight the whole length to a point inside of the packing-box, or possibly the portion between the liners for bearings can be protected by some process of plating or depositing copper, or other non-corrosive metal upon the shaft.

CHARLES SPERRY.

Port Washington, L. I.

◆

FROM THE LADY CHIEF ENGINEER.

Editors ENGINEER:

You can say to all doubters that I did write the letter in your issue of the 1st of March, and that it was a truthful and accurate account of what occurred, for proof of which I refer to the agent of J. F. Hayden's coal wharf, Bath, Me. I am known to the engineers on the fifteen ton boats plying on the Kennebec, also to some of the Kennebec steamboat companies, and to Capt. Collins of that line; C. E. Hyde, former Supt. of the Bath Iron Works, now chief draughtsman, knows me well as an engineer. Editor of the *Bath Independent*, also, all of whom have repeatedly seen me driving my boat '*Buttercup*' for all she was worth during the summers of '85, '86, '87, '88. At present I am interested in fashion books, and dressmaking. I have other experiences, and some good ideas which sometime I may write out for your up-to-the-times paper.

Boston, Mass. MRS. BUTTERCUP.

This letter is written in response to one from us advising Mrs. Buttercup that some doubting Thomases thought that a woman could not have written or have had the experiences set forth in the letter of March 1st. We saw no reason to doubt it ourselves, and print the current letter for the satisfaction of all concerned. We shall be glad to have Mrs. Buttercup write at her pleasure.

◆

FROM NUMBER 41 M. E. A., PORTLAND, OREGON.

Editors ENGINEER:

I herewith enclose list of officers of M. E. B. A. No. 41, duly elected and installed March 1, 1890, to serve for the ensuing year. No. 41 is not dead, she has only been sleeping. After laying dormant all winter she has come out in the first sunshine of spring, ready to again take up the work that has so long remained undone, and with almost a new set of officers (all of whom are young men) we expect to forge ahead again in our noble order:

Past President, Fred. Gates; President, Wm. T. Smith; Vice-President, Thos. Hardee; Recording Secretary, Claude Troup; Financial Secretary, A. Jackson; Corresponding Secretary, Wm. Coffin; Treasurer, Fred. Gates; Chaplin, Chas. Evans; Conductor, Wm. J. Maher; Doorkeeper, Wm. Lewis. Trustees: M. O'Neil, Thos. Smith and J. W. Collyer. Address Corresponding Secretary, Sixth street between Oak and Pine streets.

Trusting and hoping that the power of THE ENGINEER may never grow less.

WM. H. MARSHALL.

209 "I." Street, Portland, Ore.

◆

METALLIC PACKINGS.

Editors ENGINEER:

In the *Scientific American* of Feb. 15, page 101, was published under the heading of *Engines of the 'Augusta Victoria'* a description of said engines. In it they said: "The glands on the engines are packed with the United States Company's Metallic Packing," etc. After reading the said article we sent notice to the *Scientific American*, stating that they had made an error by saying that the stuffing boxes of said engines were packed with United States Co.'s packing, as the same are packed with Katzenstein's Metallic Packing, the same as all of the steamers of the Hamburg American Packet Co., except the '*Columbia*;' also every ship of the North German Lloyd Co., Cunard Line, and three-fourths of all foreign and domestic steamers. Up to date we do not find this error above mentioned corrected in the *Scientific American*, and thought best to send you this to show how correct the *Scientific American* is in reporting facts.

L. KATZENSTEIN & CO.

New York.

◆

GENERALITIES.

VAGUE assertions like these following are frequently met with:

The Architect and Builder says that the sons of professional men dominate in the Philadelphia Public Manual Training School. While the children of artisans are so largely striving to get into the ranks of the struggling and poorly paid professions, the children of professional men are largely taking to mechanical pursuits. Professor William L. Sayre, the principal of the school at Seventeenth and Wood Streets, states; "It is a curious fact that of the boys now in the training school and learning the use of chisels and hammers and lathes fully three-fourths are sons of professional and business men. We have many sons of doctors and ministers and lawyers." Of the seventy-seven occupations recorded of parents of boys now in the middle class, fifty-four are those of professional or business men and twenty-three those of men engaged in other pursuits, of whom only fourteen are artisans.

What are we to understand by this? That the sons of rich men, or prosperous men, are voluntarily seeking to learn trades as a means of livelihood, or that they are only tinkering for amusement? They must be doing either the one thing or the other; if the first, we find it difficult to believe that a majority of the sons of prosperous men who have never know a want unsatisfied are learning trades which, if they mean to live and support families upon, will leave many wants unsatisfied. This conclusion is contrary to common sense. The rich men's sons, then, must be only amusing themselves, and this is the only legitimate solution of the hasty paragraph above. Let them do so to their heart's content; they might be in worse business than playing in a shop.

That the children of artisans should be "largely striving" to educate themselves for professions, is also a hasty conclusion. The census of Yale would, we make bold to assert, reveal the fact that for one "artisan's" son being educated for a profession, there are an hundred or more born to the purple with the same object in view. In no age and in no country are there social revolutions such as are hinted at in the paragraph above quoted. Here and there are misplaced men who have had their callings selected for them, but the great majority of mankind choose theirs by natural selection, and not by reason of the founding of manual training schools.

◆

"I KNOW a manufacturer that was a 'worker;' he had not time to visit the mill and office much, for he must whitewash his tenements, blacksmith shops and sheds, and keep the streets of his little village in order. I do not know exactly how many times he has failed, but several times at least. He used his eyes and tongue about as the captain of a ship would who would leave the quarter deck in a gale to go and fry onions, because his cook did not know how."—*Wade's Fibre and Fabric.*

Moral: Let every man do the work he is paid to do.

◆

IN a Milwaukee packing house kerosene was put in the boiler to remove scale. The steam is used in cooking ham, beef and sausage, and produced unexpected results. The kerosene mingled with the steam, and the cooked meats smelled as though they had been dipped in a petroleum well. It was some time before the cause was discovered.

◆

BELFAST may be but a spot on the map, yet that spot is becoming a very prominent one. Within a week a barrel of vinegar was ordered to be shipped to Florida, a cargo of apples to Liverpool, Eng., a number of cats to Missouri, hoisting gear to Georgia, and a number of other articles to other parts of the country.—*Belfast, Me., Age.*

MAN, KNOW THYSELF.

"THE proper study of mankind is man," said Pope, or some one else who might just as well have said it, and this is true so far as regards our mortal frame, for a more magnificent automaton was never created. The combination of the physical and spiritual bodies is so wonderful a thing that a mechanic may well view his body with admiration and with awe. Anatomists who have made it a study, have most interesting information to give us concerning it, and in so far as they relate the bare facts revealed by dissection are trustworthy. Some of them transcend the limits, however, and border on romance, where there is no need to follow them. In the *Physiology of Bodily Exercise*, Dr. Lagrange touches among other things upon muscular exercise, and from this work we learn much regarding our bodies that is of great value in maintaining it in a healthy condition. "*Sana mens in corpore sano,*" says the proverb, which means in plain words "Sound mind in body sound" and there is the truth in five words.

With a sound body, work, mental or physical, is a pleasure. We quote a passage or two which shows the author's drift and intention:

"Does a man when he makes a slight movement comprehend the number of wheels or springs he sets rolling and uncoiling? A muscle contracts. Then the one near to it works, then another further removed, for they all are associated. I move my forearm, and the shoulder, the vertebral column, the thorax, the pelvis, all help. 'From head to foot all the muscles participate in the most insignificant and most localized work.' You cannot move without some change of the center of gravity. When I give a blow with my fist, the arm does it in part, but so do the legs and the feet. 'A well-delivered blow with the fist is supported by the whole body.' If this be the case in particular exercises, we see muscular effects produced in parts of the body which we hardly expected. There is in the planning of the muscles something which is not much thought about. 'In each limb one-half of the muscles generally have an action diametrically opposed to that of the other half.' Take the forearm. Here 'the muscles of the anterior surface have the function of flexing the fingers and closing the hand.' On the other side are the extensors. Without them the hand could not be opened again. These muscles, intended for different purposes, are called antagonistics. Between the two a balance is brought about. The one, then, regulates the other. Perfection of this muscular action comes about by exercise. In many movements it is apparently automatic. What is called the muscular sense is acquired, and, having it, we know just about what force we must expend in order to accomplish something. This sense is almost gifted with eyes, for it enables us to reach and clutch objects the position of which we know even if we are blindfolded. Carried out to its utmost limit, the absolute control of the antagonistic muscles is the stock in trade of the juggler, of the balancer.'"

We allude to these subjects for the reason that they are part of the lesson of life and of learning how to use these self-acting machines we live in.

With a knowledge of physiology man is enabled to not only ward off diseases, but to reach his allotted three score and ten years, through an economical expenditure of his physical capital.

◆

IT is no wonder that engineers of the old school can turn from one subject to another with so much versatility when we consider what an education they had. Instead of having professors to fill them with ready digested knowledge, like the young men of the present day, they moved from one position of responsibility to another, and their intellects were hardened and invigorated by constant work. Every step they took was an experiment on a working scale, and every fact they learned was imprinted on their memories by the toil and trouble it had cost.

◆

IT appears that in some English machine shops the foreman occupies a sort of pulpit in the center of the room so that he can see all that is going on. This looks like a queer arrangement to Americans.

◆

THE average price for the last ten years for standard American type (eight-wheeled locomotives), 17 inch by 24 inch cylinders, no extras, was $8,287.

ENGLISH TERMS.

QUITE at random I make up a list of articles to which the English assign names differing from those we use:

That which we call a bowl is known as a basin. In England you ask for a basin of bread and milk.

That which is known to us as a pitcher is called a jug.

A donkey is called a moke; in America a moke is a negro.

What we call crackers are called biscuit.

What we call shoes are known as boots, and what we call boots are known as bluchers. There is one shoe called the hilo, because it runs high from the heel up back of the angle and is cut low in front.

Our druggist is a chemist, many of the older practitioners retaining the old spelling—"chymist."

What we call ale is known as bitter beer.

What is known as hash we should call a stew, and what we call a hash is known as a mince.

In England our overcoat becomes a great coat, our undershirt becomes a vest, and our drawers become pantaloons.

What we call sick the Englishman calls ill; sickness implies nausea and vomiting.

They call a street car a tram; an elevator is a lift.

What we call a telegram is called a telegraph; it will probably never be determined which of these usages is the better. Our postal card is a post card; cuffs become wrists.

That material known to us as canton flannel is called swan's down, and our "muslin" is known as "calico."

What we call "stewing" (culinary term) the British call "simmering;" our "lunch" is a "luncheon," and our "baggage" becomes "luggage."

Our "wheat" is called "corn," and our "corn" is called "maize," or, sometimes, "Indian corn.

A chill is called a "rigor," and the eruption commonly known among us as "hives" is known as "nettle-rash." Candy is known variously as "sweets," "sweetmeats" and "lolly."

Writing to John Smith, your social equal, you are expected to address him as John Smith, Esq.; if he be your tailor, grocer, etc., you address him as Mr. John Smith.

The word "apt" is exceedingly popular. It is "apt to rain," "apt to be muddy," a man is "apt to go down town," a bank is "apt to suspend," etc. Even the best prints use this word as a synonyme for "likely" and "like." Another barbarism everywhere prevalent in the United Kingdom is the use of the adverb "directly" for the conjunction "as soon as"—e. g., "directly he went out I shut the door." Charles Dickens, who was quite slovenly at times, seems to have been addicted to this indefensible vice.—*Chicago News.*

◆

ONE curious fact is observable in connection with labor and capital at the present time, namely, that the leaders of labor movements and the more intelligent of their followers are watching very closely the reports of great companies and others whose accounts are published and dividends declared. The publicity and criticism of these yearly or half-yearly reports will, in the end, be advantageous, because the people will be better able to understand whether or not the state of trade will warrant a rise in wages, or justify an attempt to reduce the working hours. More light will prevent mistakes.—*Engineering.*

◆

WHAT has become of the craze for burning petroleum under steam boilers? We do not hear anything about it lately. It is interesting to note that in building the Forth Bridge crude oil lamps were largely used. A foreign journal says the crude oil was very cheap when there was no demand for it, but as that increased so did the price, until it was quadruple and hard to get at all. Moral!

PLUMBAGO PACKING.

FROM the days of Watt, engineers have been accustomed to lay up square gaskets for packing rods and buckets, and have found such gaskets, when properly made of good jute, wear a long time, for both water and steam. Not every man can lay an eight strand gasket square; somehow it will get itself flat, and there is no need of anyone spending time to do it now, for machine-made gaskets are better than hand-made. The packing here shown is an excellent one for use around steam engines. No better—which can be immediately applied in any situation—was ever made. The illustration shows a round gasket, but they are also made square. This packing is made from best selected jute, free from woody fiber or "shives," and is thoroughly incorporated with the finest plumbago. This not only lessens the friction of working rods, but actually preserves the jute itself, for plumbago is indestructible by heat and protects the gasket from it, as heat chars and soon destroys the elasticity and wear of the jute, the plumbago is a direct benefit to it. A special point should be made not to use oil with this packing. None is needed and the use of it will only burn out the jute sooner. The rod gets oil enough from the sight feed cups, now so generally used. This packing is sold by Greene, Tweed & Co., 83 Chambers street, N. Y., who will send price list on application.

TRADE-MARK.
MANHATTAN
REGISTERED, SEPT. 24, 1889 NO. 17054.

◆

THE construction of the so-called Underground Railway in London, was the means of solving a great many problems which at the time presented much difficulty. Questions which are now fully understood, and which would be undertaken by contractors as a mere matter of course, then were of very grave importance, and had not only to be exhaustively discussed, but attacked with great caution. It was not then known what precautions were necessary to insure the safety of valuable buildings near excavations; how to timber cuttings securely and keep them clear of water without drawing the sand from under the foundations of adjoining houses; how to undermine walls, and, if necessary, to carry the railway under houses within a few inches of kitchen floors without pulling anything down; how to drive tunnels; to divert sewers over and under the railways, to keep up the numerous gas and water mains, and to maintain the road traffic when the railway was being carried on underneath; and finally, how to construct the covered way so that buildings of any height and weight might be erected over the railway without risk of subsequent injury from settlement or vibration. Such questions as the admissible stress on brick arches loaded on one haunch only, the extent to which expansion and contraction of iron girders would affect buildings carried by them, the ability of made ground to resist the lateral thrust of arches, and a multitude of similar problems, had to be dealt with tentatively at first, and with increased boldness as experience was gained. As an instance of the confidence which experience gives, we may cite the following: doubts entertained by the engineers as to the behavior of a compound brick and iron structure led to a timber front being put to the Edgware-road Station, where it rested on a 49-ft. span girder; yet in 1865, when the extension to Moorgate was executed, no hesitation was felt in trusting an elaborate brick and ashlar face wall, weighing 1,300 tons, to a continuous girder 135 ft. in length.—*Engineering.*

◆

PERSONS having No. 7, Vol. 10, will confer a favor by sending it.

ARBITRARY RULING.

APPARENTLY the Vessel Owners' Association of the Great Lakes are of opinion that they possess exclusive privileges, and that their mission on earth is to meet in solemn conclave and "fix prices" for the labor employed upon their boats. If they have this right it is unquestionably in order for shippers to form an association and also regulate, or fix the prices they will pay for transportation. One is certainly as fair as the other, and the shippers should not discriminate either. They should insist upon one rate for all classes of goods. Fast freight or slow, perishable commodities or otherwise; ore in bulk or dry goods in cases, all should come under one rate and one price. Imagine the howl the Lake Vessel Owners' Association would set up if the principal shippers in all large ports should unite and agree that the above programme would be carried out. The officers would not rest a moment until they had seen each other, and had arranged a compromise Yet this is exactly what the Vessel Owners' Association on the Great Lakes has done with reference to their help. Regardless of experience, fitness or qualifications, they have resolved to pay a fixed rate of wages for certain branches of their service on their vessels, and so conscious were they of the injustice and uncommercial character of such a resolution, that they had not the moral courage to answer a remonstrance or petition from the men employed, but utterly ignored it, as the only course open to them. It is needless to say this does not dispose of the matter, and the Vessel Owners' Association is only putting off the day of reckoning. When American sailing men, engineers, captains, pilots, wheelmen and deck-officers generally cannot get an American living for their families by a hard season's work, there is going to be an investigation into the causes therefor, and those who have been instrumental or active in oppression will be brought to an accounting. It is worthy of note in this matter that the persons forming the Vessel Owners' Association were, in many cases, formerly employees themselves, and when they were such protested vigorously against unjust discriminations in the matters of pay, but since they have acquired interests in vessels themselves, they see matters in entirely another aspect, and they think all men are equal in this country, so far as abilities are concerned.

The Vessel Owners' Association is not wise in its generation, or fortunate in possessing sagacious leaders and directors. Being Americans themselves, who have risen from humble surroundings to better positions, they seem to forget that they are no more than they were before, that the conditions only have changed for them, and that they should use their early experiences with poverty and hardship to advance the interests of their employees, for in doing that they directly benefit the Vessel Owners' Association. Every man Jack of the Vessel Owners' Association knows perfectly well that when he was an officer in charge of a vessel he knew when he was paid for his work. When he was he could not do too much for the owner; when he was not the owner might look out for himself. Do the officers of the Vessel Owners' Association think that human nature has changed, and that the more the men are oppressed in the matter of wages the harder they will work? They know better; some of them do, at any rate, and these should have protested against the idiotic resolution to pay all men alike for all vessels.

The Vessel Owners' Association is extremely unfortunate in its resolution to lump all men together, and it is only building a dam against itself. Sooner or later all wrongs are rectified, and there will come a day when public opinion and concerted action on the part of the oppressed will sweep away the Vessel Owners' Association into the gulf where so many other trusts have perished.

THE ENGINEER.

FORTNIGHTLY. . . $2.00 PER ANNUM.
Foreign Subscriptions, - . . . . 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, MARCH 29, 1890. No. 7.

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The circulation of THE ENGINEER covers all parts of the United States, and limitedly in Canada, Europe, and foreign parts.

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Entered at the New York Post Office as Second Class Matter.

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GO SLOW.

"WHOM the gods would destroy they first make mad," said the Greeks, and the vessel owners of the Lakes seem to be in some danger, if not of the wrath of the gods, certainly of the wrath of marine engineers, whom they oppress by onerous restrictions and arbitrary action. This extract is from the *Marine Review*, Cleveland:

> Do the engineers want the twelve-hour bill passed as introduced by Congressman Cummings, or do they want four engineers on all boats of 1,000 tons burthen, which is the gist of a second bill, said to have been introduced by the same man? This was an open question among vessel owners and the engineers themselves did not seem able to solve the problem. If the national organization of the M. E. B. A. has thought legislation for four engineers would escape the antagonism of the owners, they are mistaken, for arrangements are being made to fight the proposed bill with more vigor than its predecessor. There are at present on most boats two engineers and a greaser, the aggregate of their salaries averaging from $235 to $250 per month. The aggregate salaries of four engineers would be at least $100 more per month, and for the whole season would draw from the owner's pockets $800,000 more than they have been paying. Will they fight such an outlay? It was whispered that they might not, that four engineers would be placed on each boat at $65 to $75 per month.
>
> In an address by National President John H. Galwey, he says: "Were we desirous of notoriety we might inaugurate a strike, stopping every vessel propelled by steam in this country, but rather let us knock upon the doors of Congress so that the echoes will resound from one end to the continent to the other."
>
> Speaking of the twelve-hour bill, a well-known engineer said: "We do not favor it entirely but it will bring about the desired results. Do you think we would desert our watch in time of need if it ran twenty-four hours over time?"
>
> The captains have taken a decided stand on the side of the owners and claim that they believe the engineers are honorable and will do the right thing when necessary, in case of this bill passing, but they also say that it places a temptation in the way of an engineer who is compelled to work over time to use the violation of law as a leverage for revenge.

Let us see what remuneration lake engineers receive for their season's work, which is not over six months in the year. At $75 per month it amounts to $450. Upon this magnificent stipend, American engineers are expected to bring up families and maintain a respectable position in the community. It is simply outrageous. The amount is less than brute force—in the shape of a policeman or a car driver in this city receives for his work for the same period—or for equal hours of labor; yet an engineer, a skilled laborer who cannot be replaced in a moment, is asked to work for this paltry pittance! Lake vessel property must be a poor investment for the owners of it when they cannot afford to pay American engineers living wages. But, says some one, $450 for six months is at the rate of $900 per year, and engineers have their time in which they can engage in other pursuits, work in the shop, or elsewhere. This is no rejoinder; jobs are not waiting for engineers when they come ashore in the fall. And as for the shop, here and there a man may get a job in one, but the majority have to depend on good fortune to find a billet. Our contemporary, *The Marine Review*, says that $800,000 more would have to come out of the pockets of the owners if more help is had in the engine room. We do not know how correct its figures are, or whence it derives its data to make them from, but the estimate is evidently a wild one, made wholly in the interests of the Vessel Owners' Association. It involves the assertion that there are 10,000 marine engineers employed on the Lakes, when there are not one-tenth or one-twentieth of that number who receive $75 per month So the owners would not be out of pocket $800,000 in a season; as a matter of fact they would not be out of pocket at all, for they would get any increase of wages they might be compelled to pay, out of shippers, or they could easily pay it, as they should, out of their own pockets, and still make a great deal more than it is necessary for any one to make out of a business venture.

Now this sets forth the situation in plain terms. Engineers want nothing but their rights, and these they are determined to have. Apparently the vessel owners feel that engineers have no rights which they are bound to respect, but a stoppage of their vessels for a week in port would speedily convince them of their error. Marine engineers are a conservative class of men. They dislike to upset and overturn, not only for their own sakes, but for the credit of their order. They do not care to be maligned, misconstrued, and lied about in the daily press, as they would be if they exerted the power they possess, but do not try them too far. Do not expect that marine engineers will consent to, or submit quietly to any sort of nonsense or juggling with "bills," for they will not. The time has gone by in this country, when workingmen of any calling can be imposed upon, for they know their strength and their rights, "and knowing, dare maintain them."

◆

STEAM USERS AS ENGINEERS.

IT is with a great deal of surprise that we find a paper called *The Safety Valve* published in this city in the interest of, and distributed by, a New York boiler insurance company printing such an article as the one we quote from. To wit:

> 'It is the constant complaint of steam users who are not specifically informed concerning the engine-room that they find their engines and boilers are misused, yet are unable to discover the cause. The only part of the engine-room that they are able to keep a lookout on is that pertaining to the use of fuel; their coal bills tell them of that. They know if their present engineer uses as much coal or more than the man who preceded him, but they find after their engines and boilers have been used for a certain time that they need renewal of parts, while a competitor, perhaps, using the same type of boiler and engine, has no such trouble.
>
> On another page of this issue of *The Safety Valve* the peculiar position of the steam-user in this regard will be found set forth, and it was with a view of informing our steam-using patrons that a representative of this journal recently called upon an experienced engine inspector, who, though too modest to permit the use of his name, we have no hesitation in saying, is certainly one of the most skillful and, perhaps, altogether the best informed man in his vocation that is to be found in these parts. Here is what he said:
>
> *Question.* How may an employer, without any specific knowledge, examine his engines and boilers?
>
> *Answer.* "First the owner should observe whether the engines and boilers are clean or not. He should see if the safety valves work freely, if the flues are clean. *If the flues are choked it will increase his fuel bill* 15 *or* 20 *per cent.* The engineer should see that everything is clean, as stated above; that the engine is not thumping; also the boilers should be kept clean both internally and externally, as in the accumulation of dirt and scale in the boiler there is a great loss of heat. The dirt or scale being between the water and heat, the loss is all the way from 15 to 25 per cent.
>
> The owner should also assist the engineer by giving him an indicator to ascertain whether the engine is working economically or not, and a card should be taken every day. The coal should be weighed, also the water and the ashes, to know the loss or gain daily.
>
> *Q.* How will the owner know if the engine is working well or not?
>
> *A.* Upon looking into the engine room if there are any loose parts he will observe it, and also the thumping of the engine on the center.
>
> *Q.* How is he to know if the parts are clean?
>
> *A.* He will see that the parts are well polished and the brass work glittering. He will note upon entering the engine-room whether or not this has been attended to.
>
> *Q.* How is he to know whether or not the fire is properly attended to?
>
> *A.* By looking into the furnace to see if the fire is level and then into the ash-pit to see if there is a bright and clear light. If the condition differs from that, the engineer is a careless man. At all times the fires should be level and the ash-pit have a clear bright light.
>
> *Q.* How should he ascertain if more power is generated than the necessities of his mill or shop call for?
>
> *A.* If there is more steam made than is required and the safety-valve is set at a certain pressure, the excessive steam will be let off at the safety valve, which is a great loss. In trying the safety valve it should only be opened for an instant to see that the parts are clear and not to be allowed to blow off a great quantity of steam, etc., etc.

IT seems necessary to inform our contemporary that it is the sheerest nonsense to talk about making engineers out of steam users, or to suppose that looking in an engine room to discover "loose parts"—whatever these may be—would result in saving money. What is meant by loose parts? One end of the connecting rod flying through the air? How is an owner to observe "the thumping of the engine on the center?"

The proposition our contemporary makes is preposterous, and its remarks show that it has no conception of the duties of an engineer, or his responsibilities. No engineer worthy of the name would stay in a place where the owner was observing loose parts, or thumping on the center, to say nothing of pottering with every gauge cock and playing with the safety valve. Such a course on the part of the owner would be *prima facie* evidence that the engineer was not trustworthy, and the sooner he got out the better. No engineer could be trustworthy in such a situation, for he would naturally expect that if the owner was constantly fooling with the plant that he—the owner—was the responsible man and not the engineer, in case an "accident" happened.

Why is it that the general public imagine that an engineer is a man who merely keeps water in a boiler and has no loose parts flying around the engine room, and does the best he can to prevent thumps on the center? Engineering is just as much a profession as the science of medicine or the practice of law. No one would call a man a doctor because he knew that a furred tongue was a sign of a disordered stomach, yet so-called trade papers pretend that steam users can pick up the profession intelligent men spend their lives at, by a few written instructions. Steam users can make more money in the counting room than in the engine room, and nine-tenths of them know this so well that they never venture into it—to observe "loose parts."

◆

THE MINISTRATIONS OF FRIENDS.

FRIENDS far and near, from the inland seas of the Northwest, from the sunny South, and from the middle states, from all over, in fact, have again laid us under obligation by their kind letters of sympathy for our bereavement. We do not wish them to feel that we read their tokens of good will and esteem stolidly, and as matters of course; far from it. Every one of them is a message from kind hearts, from brothers of the great family of Man, and we receive them as such, not at all as civil, conventional expressions proper to the occasion These letters might have been written by kindred, so friendly are their suggestions and so solicitous are they for our individual welfare. Many of them express the hope that we will not be utterly cast down, or so much so as to be unable to stand by for the cause of American engineers. So long as the Almighty wills, so long we shall stand to the fore; always on duty, doing whatever we can find to do "with all our soul, and with all our strength." In the ordinary expectation of life there are twenty years allotted to us yet, and a great deal can be done in twenty years.

May we live to see the day when American engineers shall receive the fullest recognition of their merits.

◆

COSMIC DUST.

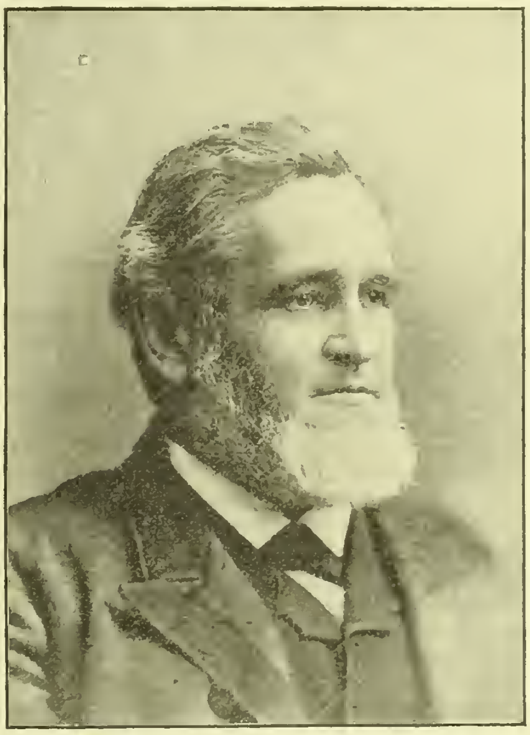
IT is a curious fact that persons who chance upon subterranean caves which have been a long time secluded from any communication with the outer world, find the floors of them covered with impalpable dust many inches in depth. The feet sink into it as into water almost, so fine is it. Whence comes this dust? The winds have not caught it up from the bosom of the earth and deposited it again. It has not sifted through crannies or chinks from the outer world, for this same dust is found in sarcophagi—tombs which have been shut for ages on ages. It is found in the interior of excavations, which are sealed hermetically from any connection with the world of nature. This dust is the detritus of the globe, the waste of the universe, which is forever consuming, forever being renewed. It is the slow combustion of the visible earth. Cosmic dust is the ash of it.

FAMOUS AMERICAN ENGINEERS, No. 8.

DE VOLSON WOOD.

DE VOLSON WOOD was born in Smyrna, New York, in 1832. His parents being farmers in humble circumstances, he was given only a common school education, but they gave him much leisure, which he diligently improved by study. He early developed a fondness for mathematics, and one of his neighbors remarked that "the stones about the farm bore records of his mathematical work."

At the age of seventeen he taught a district school, receiving ten dollars a month, doing the janitor work of the schoolhouse, and "boarding around." After teaching for three winters in his native town, working summers on the farm, he entered the State Normal school at Albany, where he graduated before he was twenty-one, and was made an assistant in mathematics in the same school, after teaching one year in Ulster county. After remaining a year and a half he attended the Renseleaer Polytechnic school at Troy, when he graduated in 1857. During the same year he started on a westward trip, visiting schools and places of interest, reaching, after a time, the University of Michigan at Ann Arbor, when, after a short conversation with the president of the institution, he engaged to teach the classes in civil engineering for a few days, or until the recently appointed professor should report for duty. It so happened that De Volson Wood, wandering aimlessly to an unknown destination, looking for something to "turn up," in less than an hour after he called at the University, began labors, which were supposed to be temporary, but which, in fact, continued for fifteen years, the other professor never appearing. De Volson Wood was popular from the first. He organized the department of civil engineering, and he and it grew in favor with the University so long as he remained.



In 1872 he was called to the chair of mathematics and mechanics in Stevens' Institute of Technology, which he filled for thirteen years, when in 1885 he was promoted to the chair of Engineering in the same institution, which position Prof. Wood now holds.

As a writer and author he is well known. He began to write for the press when he in the Normal school. At that time he developed a system of Alligation which was published in the New York *Teacher*, and for which he was awarded one of the prizes offered by that journal. This system has become historic and has been adopted by all modern writers treating of this subject. About that time Prof. Wood computed an eclipse of the sun, which was observed at the Normal building with such instruments as were at their command. Since then he has published several text books of a mathematical character, which are well known in the technical schools of this and other countries, and prepared more than an hundred articles for papers, journals and encyclopedias.

Among Professor Wood's engineering works are: The design of an ore dock erected at Marquette, Mich.; a preliminary survey of a part of the Toledo, Ann Arbor and Northern R. R.; he was an engineer at the Milwaukee Iron Works for a short time, and the inventor and manufacturer of a steam rock-drill, besides constructor of several other machines. In the early work on the rock-drill, Professor Robinson, now of the University of Ohio, was associated with him.

Of Professor Woods' speculative writings are articles on "*The Probable Temperature of the Sun's Surface*," and "*The Properties of the Luminiferous Aether*." The former was published in Van Nostrand's *Engineering Magazine*, and attracted the special attention of the late Captain Ericsson; the latter, in the London *Philosophical Magazine*, and was received with favor by several eminent scientists.

Prof. Wood has been a member of the *American Society of Civil Engineers*, and is a *Fellow in the American Society for the Advancement of Science*, corresponding member of the *Society of Architects* and of the *American Society of Mechanical Engineers*, of which he is now a Vice-President. The University of Michigan conferred upon him the degree of Master of Science, in 1859, and Hamilton College the degree of Master of Arts the same year.

Doubtless his most valuable service to the world has been that of an educator. From the age of seventeen to the present time he has taught more or less every year. When attending school he taught as a means of support. He has a happy combination of qualities which have made him eminently successful as an instructor. A hard student himself, he insists upon labor on the part of his pupils. He seeks to interest the pupil in the subject of study. His standard is not "marks" but "knowledge." He inspires the students with confidence, and impartiality and justice reigns. Some of his pupils occupy professor's chairs, where they have carried with them his enthusiasm in the class-room. His forty years as an instructor and his numerous writings have made an impress upon the technical education of the age that will be lasting.

◆

THE BOSTON TIDE MOTOR.

THE latest attempt to get something for nothing is a tide motor, so called, which is now being written up by the daily paper engineer. One, Allan Eric, a writer of this class in the *Industrial Journal*, says:

> "The tide motor referred to is a simple yet ingenious device. It consists of a float or scow, anchored by cables. These cables are wound around shafts, which project from the sides of the float or scow. The upper and lower ends of the cable are made fast and are of equal length. The float is sunken until it draws, say four feet of water, that is, two feet more than if allowed to float without anchorage. Being thus under restraint, any movement of the float, up or down, will cause a revolution of the shaft to which the cable is attached. However slight this revolution, it is an easy matter to arrange a series of gears and pulleys, by which increased movement can be obtained. Thus the shaft turned by the force of the tide, (which is enormous and irresistible) works upon the series of gear in very much the same way as the main-spring works upon the gear of a watch. The power is mighty. This increased motion, concentrated upon a central shaft, fitted with a series of speed wheels, will naturally be the power used to drive dynamos," etc., etc.

It may interest Mr. Allan Eric to know that a commercial horse-power is 16½ tons raised or lowered one foot in sixty seconds. As the tide in Boston harbor takes four hours more or less to rise ten feet, he can amuse himself by calculating the dimensions of float to give out 100 h.p. only.

◆

"GIVE me the man who sings at his work," says a writer. He can have him. Also the man who whistles at his work.

Foreign and Domestic Trade Literature.

*THE ORIGIN OF THE PHONOGRAPH.

By Edward H. Johnson.

When Professor Bell brought out the magneto telephone with which you are familiar, Edison conceived the idea of amplifying the voice of the telephone, so to speak, by producing a transmitting apparatus which would generate a much stronger current than Bell's instrument did; and by operating upon Bell's instrument as a receiver, produce a more audible vocalization, and render the instrument of wider commercial value. These experiments ultimately led to the carbon telephone transmitter now universally used throughout the world; and it was in the course of his experiments with that instrument that he conceived the idea of the phonograph. It did not dawn upon his mind, or, for that matter, upon the mind of any of us associated with him at the time, just what he had done, that is, produced a talking machine. He remarked to me one evening when pressing his finger lightly against the diaphragm of the telephonic instrument, and feeling those vibrations, "If I was to put a needle in the center of that diaphragm and make a point there, an indenting point like the point on the old-time Morse telegraph register, then draw a slip of paper underneath that needle, the vibrations of that diaphragm would be accurately recorded on that paper." Being an old telegraph operator myself, I immediately saw the force of that apparently not very sage remark, and I said, "Certainly it will, but what of that?" "Well," he said, "If we take that paper and start fresh with it, and draw it under the point of that needle or diaphragm, put a slight tension on the needle and pull the needle, it will follow the ins and outs of these indentations, that naturally would be in the diaphragm, precisely as it did move when it made the original indentations."

I said, "That is true, but what of that?"

"Well, only this; that would be a telephone repeater. Of course, if I speak in the telephone, and that produces a vibration on the receiving telephone's diaphragm, that receiving instrument is made to record those indentations on that piece of paper, and that paper is afterwards drawn under that needle, that diaphragm re-vibrated, without the action of the human voice. I have only to make that second diaphragm and her transmitter, and I will carry my message on again to another station. Thus, instead of telephoning within the limit of the capacity of a single instrument, I will telephone to those limits, and then automatically repeat the speech over another circuit, to the limits of the second circuit. In other words, you will make a telephone repeater that will be the exact counterpart of the telegraphic repeater, so well known in general use."

I said, "It looks feasible; it looks practicable."

That was the end of it for the time being. Neither one of us thought any more about it for a long time. I was in somewhat straightened circumstances, at the time, as we all were, owing to the fact that we had spent some six years in developing a system of electric automatic telegraph, which we sold to our friend Mr. Gould, who was several years paying for it, and has not yet settled up entirely. The situation was, that we had to look around and see what we could do to earn our bread and butter. Mr. Edison has since found a way of earning his. I had to strike out in some new direction; and it occurred to me it would be a very good idea to go around to the leading watering places, it then being summer time, and exhibit Edison's telephone and apparatus, and make a little money that way.

I did it by having my singers stationed in the Western Union Telegraph building in New York, having my receiving apparatus in a house like this at Saratoga, Buffalo, or Rochester, four or five hundred miles distant from New York, and reproducing the voices of these singers to my audience at those distant points. It was very successful. A great interest was being aroused in the subject just at that time.

In the course of one of my improvised talks, it occurred to me it would be a good idea to tell my audience about Edison's telephone repeater, at Buffalo, which I did. My audience seemed to have a much clearer appreciation of the value of the invention than we had ourselves. They gave me such a cheer as I have seldom heard. I did not comprehend the importance of the device at the time; but the next morning the Buffalo paper announced in glaring headlines; "A Great Discovery; A Talking Machine by Professor Edison. Mr. Edison's Wonderful Instrument will Produce Articulate Speech with all the Perfection of the Human Voice."

I realized for the first time that Edison had, as a matter of fact, invented a talking machine. The immediate importance to me was that this created a sensation, and I had very large audiences in all my entertainments thereafter. Realizing that, and having had sufficient experience by this time to profit by such things, I made a special point of this feature in my next entertainment, which was at Rochester, and I had a crowded house; one that did my heart good—and my pocket, too. There was a most magnificent enthusiasm. That satisfied me that I had better go home, and assist in preparing this instrument. I knew from my own experience in the matter that it was a comparatively simple thing to do, so I canceled thirteen engagements ahead, and went back home with these newspaper clippings. I went straight down to the laboratory, which was then at Newark, and said,

"Mr. Edison, look here. See the trouble you have got me into." He read these figures over and said, "That is so; they are right. That is what it is, a talking machine." I said,

"Can you make it?" He said, "Of course."

"Have you got any money?" I said,

"Yes, I have a little," and I had—a little. He said, "Go to New York and get me three feet of Stubbs' steel an inch and a half in diameter, and a piece of brass pipe four inches in diameter, six or eight inches long, and bring it down here, and we will make it."

I got the material, took it back and went to work. Within twenty-four hours we had a little revolving cylinder, turned with a crank, and a simple diaphragm needle, wrapped a sheet of tin-foil around the cylinder, and gave it the original phonographic sentence, "Mary had a little lamb."

Then we set it back, to see what the instrument was going to do about it. It came out to our entire satisfaction. Not as clear as it does to-day, but it was "Mary had a little lamb," sure enough. That was the original phonograph, and the starting point of an invention, which is, to my mind, the greatest thing Edison ever did.

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[*] Abstract of address delivered before the National Electric Light Association, at Kansas City, Mo., Feb. 1890.

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A good deal of absurdity is being developed in regard to the unit by which power is measured—the horse-power. Some writers gravely argue that, as a horse cannot for any considerable time exercise power capable of raising 33,000 pounds one foot high in one minute of time, we have a false standard. What difference it makes, except to the owner of the horse, whether he can or can not do this work, is one of the things that no one can find out. Horse-power is a unit that everyone understands, and horses may work all sides of it without alarming consequences. Better let it rest.—*American Machinist.*

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Persons having No. 7 Vol. 10, "Engines of the '*Louisiana*'" in it, will greatly oblige by sending it to us if not needed. That issue is out of print with us.

STRAIGHTENING CHIMNEY SHAFTS.

The deviation of a chimney shaft from the vertical is often to be traced to the settlement or giving way of the foundation in consequence of too great a load being placed upon it. In some cases it is due to the rapid rate at which the chimney has been built, whereby the mortar in the joints is unable to carry the superincumbent weight; or the chimney may have been canted from the vertical by the force of the wind whilst the mortar is still soft and yielding. There are also cases recorded in which one side of a chimney was exposed to a continuous period of wet weather, which kept the mortar soft and allowed the shaft to settle on one side.

The work of straightening a shaft is a work of considerable difficulty, besides entailing serious risks; in fact, it must be looked upon as a bold piece of engineering, and one in which the utmost caution should be used. All the conditions under which the chimney was built should be known before any work of this character is undertaken; and it will often be found advisable rather to rebuild a shaft than to attempt to straighten it. Under no circumstances should an attempt be made to restore the structure to the vertical position, by sawing out the joints, or removing courses of brickwork—*i. e.*, "cutting back," as it is technically called—unless the shell of the stalk is built solid as a whole, in one material, and is absolutely homogeneous, the brickwork or masonry being of the highest character throughout. Many existing *brick* chimneys have been successfully cut back in the hands of skillful and cautious men; but, on the other hand, many have received fatal cuts, and have either fallen under the operation or a short time afterwards, among which may be mentioned the noted Newlands Mill chimney. The cutting back of *stone* shafts is seldom attempted, there being only a few successful cases recorded. When it has been decided to straighten a chimney, the aid of a specialist or professional "chimney doctor," should be called in; for his experience and staff of workmen, etc., are essential to the successful treatment of the case.

The first operation is to determine exactly how much the shaft deviates from the vertical, and from this a careful calculation is to be made to find the necessary gap or depth of the cut. The cut should be of a wedge shape with a maximum opening at the outer circumference tapering away to nothing at the center. Allowance has to be made for settlement, so that the chimney shall not afterwards incline in the opposition direction. When the deviation is considerable, it is usual to make several cuts—*i.e.*, at several joints; but in no case should they be close together. If the shaft deviates, as a whole, from settlement of the foundation, the cut is made as low as possible. It must be borne in mind that when once a chimney has been partly cut or sawn through, its stability depends entirely upon its own weight, all cohesion at the bed joint being destroyed; it is, therefore, advisable to keep the cuts as low down as is practicable. When a brick chimney is of considerable diameter the method sometimes adopted is to cut out either one or two courses of bricks half-way round the chimney on the side opposite to that towards which the chimney leans, and replace the same by a thinner course of brick or hard stone of wedge-shape form. In executing this operation the brickwork is cut out in segments of, say, about 2 ft., and is replaced by a thinner course. The first incision is made directly opposite to the direction in which the shaft leans; the next incision is made to the right or left, and so on alternately until one-half of the chimney has been cut through. As this work proceeds wedges are driven in to keep the cut open. The cutting out can be carried out from both the inside and outside at the same time by the aid of long chisels. As soon as the cut has been made half way round, and the wedges slackened, a loud report is almost invariably heard, which is caused by the breaking of the rest of the joint. The chimney begins to move, and by slight oscillations slowly settles down on the thinner inserted course. A large shaft in Prussia, 331 ft. in height, was successfully cut back by this method.

The usual plan, however, now adopted is to make an incision boldly into the shaft, as above described, and insert, as the brickwork is cut away, strong steel screw-jacks, whose function is to support the superincumbent mass above as the masonery in the cut is removed. These jacks are from 7 in. to 10 in. in length; above and below them are placed strong wrought-iron plates to distribute the load and obtain a good bearing. When the cut has been completed, and the jacks all inserted at their proper places, the next operation is to gradually and uniformly unscrew them, till the shaft has nearly regained its vertical position. The space between the jacks, and finally that occupied by them, is filled in with solid brickwork. It is usual to commence making good the cut before the chimney has quite returned to the vertical position, otherwise the slight settlement of the new work will bring the chimney in the opposite direction.

The Townsend Shaft, Glasgow, was straightened by sawing out the brick joints from the inside; no less than twelve cuts were made in the shaft, the first at a height of 41 ft., and the last 326 ft. from the ground line. Before this operation the shaft was stated to be 7 ft. 9 in. out of the vertical; it came back in a slightly oscillating manner, and the men could tell when it was returning by the saws tightening. (See Bancroft, "On Chimneys.") A few years ago a very massive chimney, 100 ft. in height, at the Royal Arsenal Gas Works, was successfully straightened. The foundation settled, and the shaft inclined 3 ft. 6 in. out of the vertical. Notwithstanding that calculations were made which showed that it could remain more than 3 ft. out of the perpendicular without over-reaching the limit of safety, it was deemed advisable to cut it back, and this was accordingly done.

In conclusion, it may not be unnecessary to warn proprietors of chimney shafts against unscrupulous practitioners claiming to be "chimney doctors," but who are quacks and incompetent men, and yet always ready to undertake any sort of work of this description.—*Industries.*

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COMPOUND LOCOMOTIVES.

ANGUS SINCLAIR, a thoroughly practical and theoretical locomotive engineer, graduate of the foot-board and now editor of the *National Car Builder*, has recently made some tests of the compound locomotive on the Michigan Central R. R., and this is his summing up:

"The compound hauled on the first journey 39 tons for 56 miles and 163 tons for 14 miles in excess of the load pulled by the simple engine. In returning the simple engine had the heavier load by 3¼ tons. In doing the work the compound burned 12,850 pounds of coal, and used 108½ inches, equal to 68,670 pounds of water, the evaporation being 5.3 pounds of water to the pound of coal. The simple engine burned 15,650 pounds of coal in the round trip, and used 149¾ inches, or 94,791 pounds, the rate of evaporation being 6 pounds of water to the pound of coal. The simple engine used 18 per cent. more coal and 27.5 per cent. more water than the compound in doing the work.

The simple engine was exceptionally well fired, and the compound was badly fired during the trips with the heavy freight trains. The man firing the simple engine kept the steam close to the blowing-off point during the whole of the time, yet he watched his work so closely and performed it so intelligently that the safety valve did not blow once. The man of the compound appeared to think that keeping up steam was the sole purpose of a fireman's being, and he made the safety valve blow seventeen times during the trips. I reckoned that the fireman of the compound wasted five per cent. of the fuel by inferior management of the fire. Both engines were exceptionally well handled by the engineers.

In running the day express train, consisting of seven cars weighing with the load about 250 tons, from Jackson to Michigan City, a distance of 153 miles, the compound used 9,100 pounds of coal and 49,532 pounds of water. On the same run engine 282 used 11,900 pounds of coal and 57,128 pounds of water. The saving of coal by the compound in comparison with the simple engine was 23.5 per cent. and the saving of water was 13 per cent.

When the compound has sufficient load to work cutting off at half stroke with an open throttle she can do the work with a saving of about 25 per cent. over the simple engine. Having to throttle the steam detracts from the economical performance of the engine. If this has to be done constantly a point is soon reached where compounding is of no advantage. The moral of this is that a compound locomotive ought to be designed for the work she is to be engaged on.

The only oils that there is any inducement for using sparingly in railway practice is the high-priced cylinder oils, and in that case it is the very worst policy to make the supply less than what is needed. The proper way to economize on cylinder oil is to use sight lubricators that will measure out the oil as it is required. When these are employed and a fair supply of oil passed through them, the rubbing surfaces will be kept lubricated with the least possible expense and the deduction in friction will make the engine much more efficient. The practice of oiling the valve and cylinders at intervals when the steam is shut off is one of the most persistent ways of spending constantly to save a little outlay in first cost of apparatus. A serious mistake, however, often made by those who have introduced the use of sight lubricators is the assumption that the improved method of oiling will save the greater portion of the oil previously used. A sight feed cup that works properly will generally save considerable oil from what has previously been poured in through a common cup, but the special advantage of an improved lubricator is that it supplies the oil to the rubbing surfaces at the time it is most wanted. If the same quantity of oil is used by a steady feed that was used by the interval system of oiling, the steady feed is certain to be by far the most economical of the two. This is a fact which the men responsible for the care of locomotives need to clearly understand. For want of a proper conception of the real advantages of a steady feeding apparatus, those who have introduced sight oil feed cups have often reaped no benefit from the change.—*Angus Sinclair.*

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AMERICAN FISHING RODS.

THE first split bamboo rods were made thirty-five years ago by Sam Phillips, of Easton, Penn. Phillips was a great tinker, and made and played violins, besides dabbling in fish rod architecture. The rod is made of three joints with a round butt of hard wood. The tips are of four strips of split bamboo worked down till they are round. The good quality of bamboo to be obtained in those days is apparent from the fact that the rod is serviceable yet, and that, too, with the enamel worked off the bamboo in making it round. The rod weighed twelve ounces.

Green & Murphy, the Newark rod makers, soon after began manufacturing bamboo rods, and it is said by some that they were the first to make the rods. The Newark people improved the rod by making six strips which added strength to them.

The split bamboo rods now turned out are marvels of workmanship. Made by machinery, their price has come down so as to be within the means of almost every fisherman, and if properly taken care of they will last for several years. Those made by hand are of course more expensive and more carefully put together.

For trout fishing, as neat a fly rod as could be desired is now made, weighing four and one-half ounces. It is a little over eight feet long. The tips are made of eight strips of bamboo. Many will not believe in the eight strips till a piece is cut through transversely and shown them. The little splints are not as thick as a darning needle, yet when glued and spliced they make the strongest kind of a tip. Ferules on the rod are of genuine silver and so are the guides or rings. A handsome piece of highly polished locust wood or hard rubber forms the swell of the butt, where it is grasped in casting.

The hand-made split bamboo trout rods of fine finish are priced as high as $45, including an extra joint and two tips. Cheaper rods of just as good material, but lacking the fancy finish, will be found as desirable. Extra fine salmon rods of twenty feet cost as much as $100.

The two thousand dollar rod which was made for exhibition at the London Exposition is now being made over. New wood is being fitted to the old mountings. These are of solid gold, as well as the rings, which are tied on with gold thread. The gold reel that accompanies the rod cost $600. There is a big topaz set in the butt and even the plugs are adorned with precious stones. All the gold work is engraved and chased. It is not likely that another rod like it will ever be made, for, while beautiful to look at, its usefulness on the stream is questionable.

A great difference is often found in rods made apparently alike. The spring of the wood seems to be different. Bamboo is very variable, and great care in selecting the pieces is required on the part of a successful rod maker. The strips are cut from the cane with a circular saw and then worked down by planing to hexagonal segments. In the planing the fiber is closely scrutinized and a sharp lookout is kept for flaws. When polished smooth two at a time the strips are glued together till the joint or tip is complete. In the latest rods the butts are made more pliable; that is, there is more spring just below where the second joint fits in. The result is that in striking the fish there is not so much snapping off of joints at the ferules, and the spring of the rod is apt to hook the fish. They are not double action rods by any means, but the springing action is more evenly distributed through them.

From the big, heavy twelve foot rod of Izaak Walton to the modern four-and-a-half ounce split bamboo is certainly a wonderful step. Every season some new device has been found to improve the workmanship and action till now the trout rod seems almost perfect.—*N. Y. Times*:

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"WHY do you oppose this thing?" said a friend of *Industry* to us some time ago. The remark needs a general answer. We oppose nothing, and promote nothing, except as it is conceived to be good or bad, true or false, and in such position are like all others—liable to error. Views and opinions respecting technical and industrial matters are subject to the test of experience and future results, and on these grounds we are willing to be judged. We have not been backward in summing up the merit and chances of various new industrial ventures, and do not propose to be in future, so long as there is the advantage of arriving at the truth. Some people think all schemes are good and make "business," but the fact is, one failure prevents a dozen successes. Enterprises and investments are based on confidence. It is failures that destroy confidence.—*Industry, San Francisco.*

[This is just; we have been meaning to say so ourselves, but never could find such good words for it]

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THE World's Fair bill was passed by the House, March 25 ; 1893 is the time, Chicago the place, and women are allowed to be on the Board of Management.

EIGHT HOURS A DAY.

An important step toward a uniform shortening of the working day of mechanics and laboring men is that which has been resolved on by the American Federation of Labor, composed of labor organizations which include nearly 600,000 members, and which has held annual conventions since 1881. At Boston, last December, the Federation formally resolved to begin on May 1 next systematic proceedings to secure the adoption of the eight-hour day for all classes of working people, without corresponding reduction of wages, and it laid, for the purpose of providing the necessary funds, an assessment upon its members of ten cents a week, commencing with the first week of the present month. Unless, therefore, some change has occurred in the situation of which I am not informed, the movement may be said already to have begun, and in a short time we shall see some of its fruits. The method to be followed, as I understand it, is to select one trade, and to make the fight on behalf of the men engaged in that trade first, leaving the others to be taken in hand subsequently. If employers will not consent to the reform voluntarily, strikes are to be ordered, and all the usual means of warfare are to be employed, as in case of resistance to demands for higher wages and for other advantages.

Plainly the success of this movement depends entirely upon the unanimity with which it is undertaken and carried on. If even no more than the 600,000 members belonging to the Federation stand harmoniously by one another, they will be irresistible. I have watched for fifty years the struggles made in this city by employers against the trade's unions, and the balance of victories has been on the side of the unions. Even when they have been beaten it was, as the result proved, merely because they mistakenly demanded more than the state of the labor market warranted, and in every defeat they so demonstrated their power to hamper and to annoy their opponents as to make them loth to provoke a fresh encounter. * * *

But can unanimity in demanding an eight-hour day be secured in even the skilled trades? It is evident that the leaders of the movement are not sure of this, and hence they have resolved to try it first with one trade only, but they are making efforts, by means of argument, to convert their constituents to their views. A workingman naturally fears that, as he himself will not pay so much for eight pounds of flour or of sugar as he will for ten pounds, so his employer will be indisposed to pay him as much for eight hours' labor as he will for ten. The answer to this is, of course, that he must be forced to pay it whether he likes it or not. But, supposing he is forced to do it, finally, with or without a preliminary struggle, and that all other employers are forced to do the same, then, since the product of eight hours' labor, everything else being equal, cannot be so great as the product of ten hours, there will be one-fifth less product of labor to be distributed among consumers, and, therefore, the same amount of wages will buy one-fifth less of everything which the laborer needs than it did before. This I understand the promoters of the eight-hour movement to concede, but they say that one-fourth more workmen will necessarily be employed, and thus the total product will not be diminished. Still, there remains the objection that this additional fourth will be entitled to its share of the total product, and the result will be, none the less, that eight hours of labor will give to the man who performs it only eight-tenths as much of what his wages will buy as ten hours will. I have read with care all that the Federation has published on the subject, and I do not see that they make a satisfactory answer to the objection. On the contrary, they lay great stress upon the benefit that would ensue from converting the present army of non-producers and therefore non-consumers into producers and consequently into consumers.

Of course if, out of pure good will, workingmen choose voluntarily to give away one-fifth of their present employed time to their unemployed brethren they will exhibit a generosity which will do them great credit. If, by the reduction of the working day from ten hours to eight hours, the hands now idle can be supplied with work, it would be a splendid thing. Only I fear that the benefit conferred would be merely temporary, and that it would soon require to be supplemented by a fresh sacrifice. On the edge of every mass of employed men a fringe of unemployed is always accumulating from causes beyond human control. This mild winter, for example, which could not be forseen or prevented, diminishes the demand for coal miners, and, in this latitude, throws ice cutters out of work. The demand for all kinds of manufactured goods fluctuates with the fluctuations of trade and the caprices of fashion. A war creates a temporary scarcity of laborers, and then peace comes to glut the market. How any shortening of the working day will prevent these calamities passes my comprehension, as much as does its power to increase the value of his work to the worker.

In my judgment, therefore, the success of the eight-hour movement depends entirely upon the extent to which those who are asked to support it are prepared to surrender the required portion of the time they now devote to work, and of the earnings which that portion of time brings them, for the sake of better enjoying the remainder, or of benefiting their unemployed fellow men. This is the question really to be decided, and it seems to me to be a mistake to endeavor to obscure it with economical and arithmetical fallacies. Until eight equals ten, no sophism can make eight hours' work as productive as ten hours, and the man who makes up his mind to work only eight hours must prepare himself to accept only what eight hours' work will yield him.—*Matthew Marshall, in N. Y. Sun.*

HOW ENGLISH BOYS LEARN TRADES.

The Artisan Reports on the Paris Universal Exhibition of 1878, published by the Society of Arts, says this, from a report by a working mechanical engineer:—"In England at the present time as soon as a boy is sent to learn a trade, all mental instruction is discontinued. He conceives he has only to learn to work, and in this he is very much encouraged both at home and in the factory—at home by the indifference of his parents, in the factory by the indifference of master and foreman. In fact, he is looked upon as a nuisance and in the way for the first year or two; he is set to do the most trifling jobs, and discipline is often so loose that he becomes a confirmed skulking sloven, his powers of mischief being the only faculties that evince development. The reason for work being done in a particular way is rarely put before him, and it is only when he is grown to almost man's estate that he begins to be regarded as of any value. The foreman, perhaps, notices what branch he shows most aptitude for—vice, bench, or lathe—and to this he is put and kept for the remaining term of his apprenticeship. By these means he becomes, perhaps, a fair turner or fitter, but rarely both. The neglect of mental training during his apprenticeship is so absolute that he is a worse scholar by far than when he left school. The habits of the most recent years of his life are not easily shaken off. Hence, even when he begins to be aware of his deficiencies, he is rarely to be found attending a science school. He lives and works—it may be steadily and soberly—but at the best like a mere machine. In many cases he does not know how to make the simplest calculation in relation to his work. Moreover, it is well known that the ever-increasing competition in production has led to the employment in many trades of children to do work of a mechanical kind requiring little skill; but while thus employed these young people have little opportunity of learning those parts of their trade in which skill and special knowledge are needed; and when they are grown up and seek higher wages they are dismissed to make room for other children. Numbers of young men are thus thrown upon the labor market, competent to do nothing more than children's work and to earn children's wages, and knowing no trade to which they can apply their hands.

"It has been frequently stated in recent years that the system of apprenticeship is practically dead, or at least is quite unsuited to the conditions of the present times. In the trades connected with engineering, apprenticeship is certainly not dead, although, like many other things, it may have lost much of its reality. The trade's unions have always insisted upon it so far as they can, and so have the masters, at least in the matter of wages. What we want is not a new-fangled system of schools, which would become an intolerable burden to the community, but rather an improvement and extension of those we have, coupled with a higher sense of duty on the part of the employers and employed to those who are fitting themselves to become tradesmen. If we had proper systems of elementary and secondary education, the great majority of those engaged in trades and crafts could get all they required in properly organized evening classes during the time they were serving their apprenticeship. No one should be considered a journeyman until he has reached the age of twenty-one, however long he may have been in the workshops, although those who had been at least five years should be ranked as improvers and receive wages in proportion to their skill as workmen. A minimum of at least three years in the workshops should be required of all who were admitted as journeymen. Arrangements would thus be made which would suit the convenience of boys leaving both the elementary and the secondary schools, the latter of whom would be able to make more rapid progress than the younger boys, not only on account of their greater age, but also because of their better preliminary training."—*Prof. Henry Dyer.*

There have been in ten years only about one hundred deaths in the whole world from artificial electrical currents. The railroad kills annually over 2,500 people (2,541 in 1880), and injures about 6,000, in the United States alone. Electrical currents produce three kinds of severe accidents; they kill at once, or they burn severely, or, by the mental and physical shock, they cause traumatic neurosis. Usually, if they burn severely they do not kill; hence, practically, the rule is, if contact with electrical wires does not kill, the victim gets only a burn or a harmless shock. In very rare cases the current seems to affect the nerves or nerve-centers, causing paralysis.—*Medical Record.*

One of the most curious draw bridges in the world is in St. Ann's Bay, Island of Curacao. It is a pontoon bridge, and one of the pontoons is a steamer. The steamer was built in Camden, Me. It is a scow 40 feet long, 12 wide, and 7 deep. There is a single shaft through the boat that has a 40-inch screw on each end, turned by two 9×12 engines. When the draw is to be opened the captain casts off the lines and sets the propellers a whirling, and thereupon half the bridge swings around far enough to let the coming ship pass through. Then the wheel is reversed and the gap is closed.

It is stated that the experiment of burning crude petroleum instead of coal proved unsuccessful, and the Palmer Wire Mill, at Palmer, Mass., has again changed to coal.

Oh! maybe if some one tries a few more experiments they can prove that petroleum is cheaper than coal as fuel!

ABUSE OF MEDICINES.

THE advance in medical science has been rapid in the last score of years, and to-day drugs are but comparatively little used, and the main reliance is upon food and hygienic measures. The public have not recognized this fact; it still holds that medicine is the all-important need in sickness, and that the duties of the physician are limited to its administration. Still full of the importance of drugs, people use them on themselves when ill, and when they recover, as likely as not they continue their use, thinking to keep themselves well. In the majority of cases, in both instances, they are wrong; in the latter, certainly, they are never in the right, for a well person not only does not need medicines, but is positively injured by them. Dr. Oliver Wendell Holmes said: "If all medicines were thrown into the sea it would be better for mankind, but bad for the fishes." This expression is very generally wrongly construed. Medicines can never be entirely dispensed with. Dr. Holmes never attempted to discourage their use by those fitted by proper training to apply them wisely. But they who are rightly endowed to do that are but as "a grain of sand." When it is considered how wanton is the general use and abuse of medicine—self-administered by millions of people absolutely ignorant of its properties, its purposes, and the conditions under which it can do good and not do harm—then none will question the truth of the sweeping assertion made by Dr. Holmes.

No one needs to be told that many of the tools which workmen use are dangerous to those who trifle with them. Medicines are the physician's tools, and they are the most dangerous to those who do not know all about them. Before a physician—all the name implies—prescribes for his patient, he must carefully consider not alone the disease which is suffered from, but the particular phase of it, and its period of development; he must also weigh the peculiarities of temperament and individual susceptibilities, fully realizing that "one person's meat is another's poison." There are many different diseases which have at some period in their course similar symptoms, which, however, signify opposite conditions, and require essentially different treatment.

The same medicine doing good in one case is capable of doing much harm in another. Consider, for instance, the same skin disease in two patients. An application which works well and speedily and cures one, may, when used by the other, on account of some peculiarity about his skin, set up a most painful erysipelatous inflammation. Again. there are the preparations of iron, admirable tonics. In the case of a person suffering from poverty of the blood and attendant weakness they would do good. But those who suffer from digestive disturbances, and are what is called bilious, almost always consider that they need a tonic, and as a rule, take some form of iron. They do not improve, but grow worse under its use.

It is safe to say that people who oftenest prescribe for themselves really know the least about them. It is he who is ignorant who is constantly deluging himself with drugs. Generally the injury done does not follow immediately so that it may be traced directly from cause to effect, but sometimes it does.

A physician is often a good deal like a man on the sidewalk before a house trying to tell from the appearance of the outside who is inside. He watches this door and that door, this window and that window, and listens to every sound. Every faculty has been sharpened by his training; his work is "second nature," and nothing escapes him. On the alert, he studies the patient, noting this and that symptom as it appears, and finally a complete picture of the disease is before him. —*Boston Journal of Health.*

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D. MORRIS, assistant director of the Kew Gardens, London, claims to have discovered a way to raise sugar cane from seed instead of from cuttings, the usual method.

ELECTRIC BELTS AS REMEDIAL AGENTS.

I COULD never understand why people have so much confidence in the so-called electric belts and clothing. The belief in their efficiency is not confined to the laity, for I find many doctors also believe in them.

* * *

The truth is, there is no such a thing as an electric belt. They are a delusion and a snare. I had a physician call on me, and he said, "I have tried one, and when I was in a state of perspiration there *was a mild* current passing through me all the time."

I received a call from a party, in company with his lawyer, who was trying to get a patent on a new electric belt. The officials have found out the whole thing is a fraud, and refuse to grant a patent unless they procure the testimony of some electrician that there is a current of electricity passing through them. I gave them my opinion which was not flattering. But they persisted that theirs was built on a new plan, and would do what was claimed for it.

I took my galvanometer, and promised if he could show me two milliamperes, I would give my testimony in its favor (knowing it to be impossible for it to do so). With a fine copper wire he connected the whole belt, and I placed it in circuit, and there was not the slightest movement of the needle. He had a brass rod, and hanging to it were six small compasses. The belt, when held in a proper position, would deflect those a little. This was what he claimed should warrant its introduction as a remedial agent. But that is not electricity; it is magnetism—quite a difference—and the sooner the fact is learned the better.

If a belt could be made that would give a mild current when worn, and one that could be increased or decreased at will, it would be a good thing when recommended by the family physician for certain conditions. All throat diseases would be much benefited, and other cases I could mention. But even then, it should only be worn when advised by one who knows the disease and the action of electricity on said disease.

That mild currents of electricity are good for the throat, and its own peculiar diseases, is clearly shown by the string of amber beads. It is a fact that in a string of beads there is a constant current of static or frictional electricity constantly passing that will be shown by the milliampere meter. Amber was the electron of the Greeks, and is truly electric.

My daughter, when a child, was constantly troubled with false croup. I tried every known method of relief, and at last placed a string of large amber beads around her neck. From that day she had no trouble for at least three years, till, thinking she had outgrown the trouble, they were left off, and inside two weeks she had the croup as bad as ever. The beads were again worn, and she has never had a return of the distressing disease since.

I know of many cases in my own practice, and of others in the hands of brother practitioners, that amber worn around the neck proved of great benefit. Dealers tell me they always make large quantities of amber beads, to suit the pockets of all, knowing the doctors will order some one to buy them for throat troubles, and that they sell thousands of strings.—*The Medical Summary.*

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PROFESSOR THURSTON has a delightful paper in the *North American Review*, entitled "The Border Land of Science." He tells us that in science the border land between ascertained facts and workable theories is ever receding farther and farther. * * * "Men and women alike will be larger, grander, stronger. They will be more developed in the lungs and chest, and their stomachs and digestive organs will be larger." Great heavens! Is the coming race to have larger stomachs than the present one? Then let us be glad we are going to get out of it.—*Berkshire Courier.*

FIRING HEAVY GUNS ON SHIPBOARD.

THE attention of the Navy Department has been called to trials of great guns on board the British warship '*Trafalgar*,' on account of the important bearing which the results obtained will have in determining the size of the guns to be used on the new battle ships. The '*Trafalgar*' carries four guns of a calibre of 13½ inches weighing 67 tons. They are placed in two turrets amidships, one forward and one aft. The guns are of the latest make. The full service charge of powder weighs 630 pounds, and the projectile 1,250 pounds. The shell is 40 inches long, or just about three times its diameter. On account of the way the guns are mounted, the axis of the bore, when the gun is trained parallel with the deck, is but 3 feet 9 inches above it.

This trial was looked forward to by all naval officers, for it was feared that the discharge when the muzzle was over the deck would prove disastrous to the deck beams. This fear was well grounded.

The firing began with the guns in the forward turret. Half charges of powder were used for three rounds. Two charges were fired directly ahead and one 75 degrees forward of the beam, the charge fired ahead was with the gun parallel with the deck. Some wooden chocks left lying under the capstan were blown overboard, but no damage was done to the ship. Then a charge of 472½ pounds was fired dead ahead. This blew a thumb screw off a cable cover, and when another charge of like weight was fired 82½ degrees forward of the beam the blast tore off the loosened cover and knocked a wheel off the capstan besides.

This damage was considered so slight that Capt. Dornville, in charge, ordered a full service charge to be fired dead ahead; fortunately for the ship he had the gun elevated three degrees, which brought the axis of the bore over five feet above the deck, and gave the gas a rising impulse as it left the gun. Nevertheless, the charge permanently depressed the deck, where the full blast of the powder was felt, by two inches, as the officers admit, but really more than that, it is asserted by the London papers. The deck beams were bent, and one mess-deck stanchion broken short off. The next shot fired was with the muzzle well out to starboard, where no damage could be done. The important question of what the effect on the ship would be in case the guns were fired horizontally and dead ahead a dozen times in succession, as would very likely have to be done in battle, was left unanswered, save by inference.

The charges fired from the after turret are relatively unimportant, because but one of the dozen was fired with a full service charge. It was demonstrated, however, that a gun of this great size could be loaded and fired three times in 9 minutes and 7 seconds.

If a gun with a bore of 13½ inches has such a disastrous effect on its own ship as this one had, it appears certain, of course, that the larger gun—16-inch bore—proposed for the new American harbor defense ship had better not be built, unless, indeed, it were worth the expense as an experiment and for the sake of training American gunmakers in their art. It is asserted that no gun of modern make above 12-inch bore has ever been fired horizontally, fore and aft, above a ship's deck with a full service charge without serious damage to the ship. Not over three such shots have ever been, anyhow, but several more that nearly corresponded with those conditions have been fired—notably those on the '*Anson*'—and in all cases the result tended to show that the guns were too large.—*New York Sun.*

◆

KOKOMO, March 21.—The largest plate of glass ever cast in the world was drawn from the annealing furnaces at the Diamond plate glass factory at Kokomo, Thursday afternoon. It measures 145 by 195 inches, weighs 2,000 pounds, and is perfect.

TRADE NOTES.

WITH a view of testing the rapidity of electric welding, twenty pieces of one-inch common round iron bars with rough ends were recently welded together by two men in thirteen minutes.

* * *

D. MCLEOD COBB, C. C. Cobb, S. A. Cobb, and L. De T. Cobb have incorporated the South Brooklyn Engine Works, with a capital of $50,000, for the purpose of building Lighthall surface condensers, etc.

* * *

EDWARD P. ALLIS & CO. at Milwaukee, will soon be merged into a stock company with a capital of from $1,500,000 to $2,000,000. The stock will all be held by the present management, and the change is made from a firm to a corporation, merely to simplify and facilitate business.

* * *

EDWARD P. ALLIS' Engine Works, Milwaukee, Wis., have contracted to furnish the West End Electric Railway Company, of Boston, Mass., eight engines of 1,000 h.p. each, and one of 500. These are to be triple expansion and will make 13,000 h.p. that the West End Company has in its station.

* * *

IN Neenah, Wis., at the Winnebago Paper Mills, a workman was sent to shovel snow off the roof. In jumping from one roof to another he alighted on a skylight which was hidden by snow. He fell 20 feet, and dropped into the working parts of a 300 h.p. engine. The employees rushed to the spot, and as they looked saw the man creep under a crank-shaft and walk out uninjured.

* * *

PETER SMITH, of this city, has issued the appended notice: I respectfully announce to the steam using public and my fellow engineers, that the well-known firm of Hine & Robertson, steam specialties, 45 Cortlandt Street, New York City, have the sole agency for the sale of the Hurricane Automatic Flue Cleaner. All orders from the trade and individual consumers should be sent to them in the future.

* * *

A COMPANY for the exclusive manufacture of steel boilers of all types has been formed, consisting of F. F. Cleveland and Wm. Hardwick (firm of Cleveland & Hardwick), L. G. Skinner and Frank Connell, of the Skinner Engine Co., together with H. R. Barnhurst, late of the Stearns Manufacturing Co., all of Erie. The brick building, 60 × 150 ft., is now under way, and will be fully completed in about two weeks. All the machinery has been ordered, and will be in place ready for business within sixty days.

* * *

THE twenty-first convention of the American Mechanical Engineers will be held in Cincinnati, Ohio, beginning May 13. This date occurs in the week preceding the musical festival in that city, and is so chosen that any so desiring may enjoy both reunions for one journey. The paper for the Cincinnati meeting should be in the secretary's hands before March 20, and intending contributors are requested to send him the titles of their papers at once. Send also queries for the Topical Discussions immediately.

* * *

JENKINS BROS., 71 John Street, New York, have issued a catalogue and price lists of valves, gauge cocks, the well-known "Jenkins" packing, and other specialties made by them. This price-list supersedes all others, and, as it differs materially from all others, should be in the hands of all users of these goods. It has been customary in the valve trade to quote very large discounts. This, Jenkins Brothers think is detrimental to the trade, and they have reduced their price-list and lowered the discounts. A large variety of valves are illustrated in the catalogue, and there are illustrations of other of their products.

* * *

MECHANICAL and mining engineers, with Andrew Carnegie as Chairman, met lately at the Engineers' Club, 10 West Twenty-ninth street, to make arrangements for the visit in September next of 250 members of the Iron and Steel Institute of Great Britain. There will be a meeting of the institute in New York City, followed by a meeting of the American Institute of Mining Engineers. Then there will be an excursion of five or six trains and about 1,000 people to Pittsburg, where there will be a two days' international session. Afterward there will be excursions to the North, the West, and the South. The visitors will be in America a month.

* * *

THE range finders for the United States cruiser '*Baltimore*' have been subjected to an official test. Seven observations were made with an extended base line and an error of only 44-100 of 1 per cent. was recorded against the instrument. The officers aboard the '*Baltimore*' speaks in high terms of the new device, and are anxious to pass upon its accuracy in actual gunnery tests. No attempt was made in the manufacturing of the '*Baltimore's*' range finders to turn out showy instruments. Lieut. Fiske, however, proposes to introduce metals into the future range finders which will make them decidedly attractive. Officers argue that an efficient device costs high, no matter what it is, and that in a vessel such as the '*Baltimore*,' fitted with expensive and handsome contrivances, the range finders should be in keeping with the surroundings.

A BILL for salvage was filed recently in the Clerk's office of the United States District Court by Thomas A. Scott, of New London, for $65,000. There are two claims in the bill, one for $50,000 on the steamer '*City of Worcester*,' and $15,000 on the cargo of the steamer. The bill is against the Norwich and New York Transportation Company. January 12, the steamer '*City of Worcester*," while proceeding from New York to New London with a cargo of cotton, merchandise, and express matter, ran upon Bartlett's Reef, filled with water, and was in danger of total destruction. Scott went to her assistance and took off her passengers and crew. He then saved all the cargo, which was valued at $150,000. After lightening the vessel he succeeded in floating her from the reef. This necessitated the employment of a large force of men, divers, and others. He took the '*City of Worcester*' to New London and then to New York for temporary repairs. She was then returned to New London. The steamer is worth $300,000.

* * *

AT Paris about 50,000 tons of structural steel was used, but our World's Fair project is much larger. The iron and steel used in the buildings will only be a fraction of the total demand, as there will be large calls for railway, bridge, and other purposes, that will help trade. The orders for structural iron will have to be distributed. No one firm would take the entire contract even if it could fill it. Pittsburg makes half the structural iron in America, and it is safe to say will get half the Fair work. Macintosh, Hemphill & Co., who bought the Centennial Exposition main building, which covered twenty-three acres, say there were about 6,000 tons of wrought and cast-iron in it. The colossal iron tent talked of at Chicago, they estimate would require ten times as much material. A pioneer in the Pittsburg glass trade estimates that 50,000 feet of common window glass at least will be required. One thousand feet is ordinarily considered a large order for a single building. A correspondingly large amount of flint glass would be used and the demand for plate glass upon the ground floor would be enormous. It is estimated that these needs will have an important bearing upon the glass trade the coming two years.

* * *

THE Gundlach Optical Works of Rochester, N. Y., have just completed an eye-piece for the great Lick telescope. The eye-piece is constructed on a perfected theory and is a great deal larger than any before made. Eye pieces of the same pattern are in use in many of the observatories in the country, and everywhere excellent results are obtained. The Gundlach glass uses all the light gathered by the large field lens and at the same time covers the area of the larger glass of the telescope. There are two lenses in this eye-piece. They are six inches apart. The larger one is called the field lens and is 6½ inches in diameter. The other lens is the eyeglass proper. It is three inches in diameter and is composed of three lenses, a double concave, double convex, and meniscus, cemented together. The field lens is of crown glass. The concave and convex lenses are also of crown glass. The meniscus, or correcting lens, is of flint glass. No other eye-piece of anything like equal dimensions has ever been made. The largest now in use is not over 2 inches in diameter, and that is far above the average size. The light from heavenly bodies seen through the Lick telescope and this eye piece will be 20,000 times as bright as that seen with the naked eye.

* * *

THE Farrell Foundry and Machine Company are just completing a new foundry building, which has probably the most costly roof of any similar building in Connecticut, if not in the country. It is a three-decker, built of iron trusses. The roofs are covered with sheet copper just as it comes from the mill. It is in strips, two feet wide, and long enough to reach from the eaves to the edge of the roof. This is laid in strips, and the edges, bent at right angles with the roof are clamped together and bent over again. No solder is used. The roofs contain a trifle over 33,000 square feet of copper; or 38,000 pounds. This is worth at present 22 cents a pound, making the cost of the covering $8,360 for the material alone. The upper section of the roof is one immense glass skylight, containing over 6,000 square feet of glass one quarter inch thick. Wallace & Sons, copper manufacturers, are building a new office, the roof of which is also covered with copper. This will cost several thousand dollars when completed. Several years ago the Seymour Manufacturing Company of Seymour adopted this style of roof when copper was much cheaper than now. Two years ago the building was destroyed by fire, and so valuable was copper at that time that the ruins were thoroughly searched for every fragment which, found, proved to be worth more to the company than the original cost of the roof, with the cost of labor added. It is estimated that the roofs on the new foundry building will last for 100 years.

◆

A STEADY, methodical man does more work and better than one who tries to do the work of a week in a day. Yet nothing shortens life like laziness.

◆

THE Ss. '*Pizatti*' (formerly '*City of Mexico*'), sailing out of this port, has a brass screw which cost $2,500. It won't do to lose many of them.

A PLATFORM RAILWAY.

MESSRS. RETTIG, two German engineers, have recently evolved a new idea in the matter of street railways. Observing that even a fat man can manage to mount a tramcar in motion, Messrs. Rettig propose to use, as their rolling stock, three continuous platforms moving along the streets side by side. The lowest of these platforms is 4 in. high and moves at a uniform speed of 5 ft. per second. Any ordinary pedestrian can, they state, mount this platform from the ground without difficulty, and from this he can with equal ease step on to a second platform, 4 in. higher than the first, and moving twice as fast. The passenger thus acquires a speed of 10 ft. per second, and stepping on to the third platform in the same way he is carried at a speed of 15 ft. per second or ten miles an hour to his destination, where he steps off in the inverse order. The inventors claim that with their system no time is lost from stoppages, and the passenger steps off wherever he wishes, and is not compelled to mount or dismount the train at fixed stations only. On the other hand it would seem that as the moving platforms are to be several miles long and in triplicate their first cost and working expenses would be prohibitive—to say nothing of the difficulty of finding a site for them—though mechanically speaking there is nothing impracticable in the idea.—*Engineering.*

[Nothing new either. It was illustrated in the *Scientific American* twenty years ago.]

◆

THE moment a man forgets what is due the uniform of his country, at home or abroad, in social or military life, strip him of it.—*Marine Journal.*

CLUB RATES FOR 1890.

IN former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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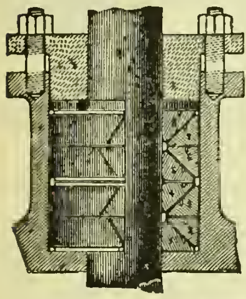

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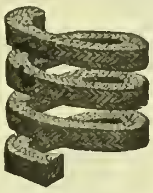

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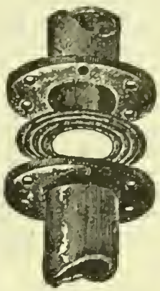

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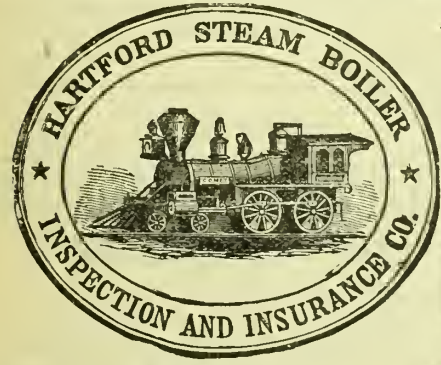

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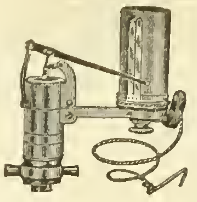

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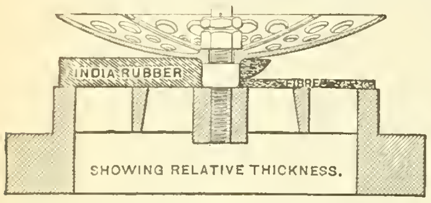

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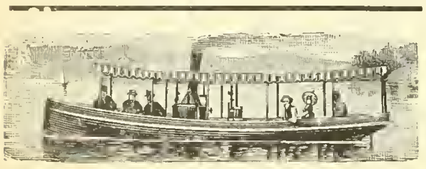

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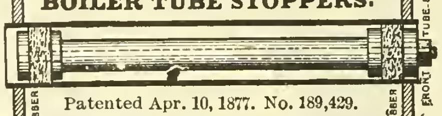

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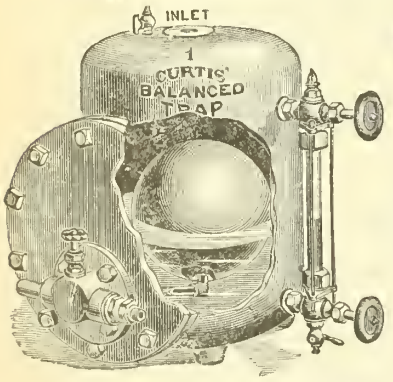

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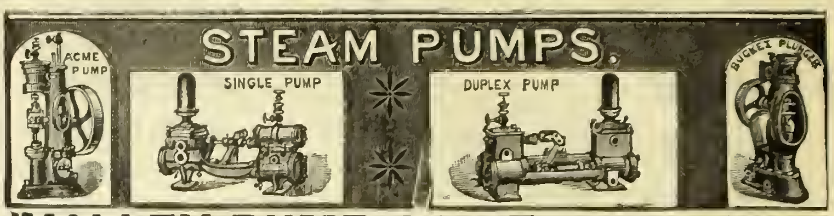

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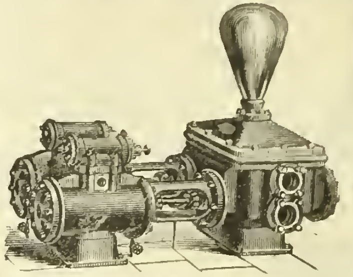

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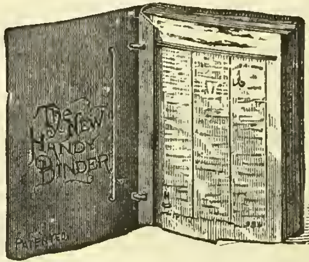

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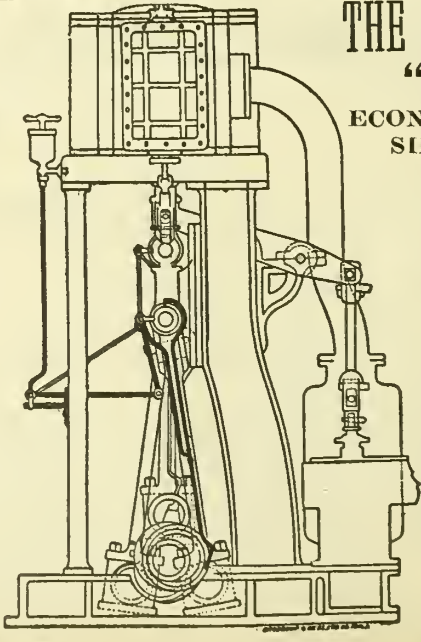

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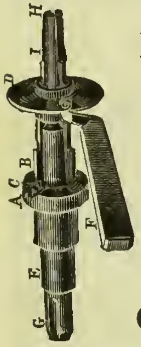

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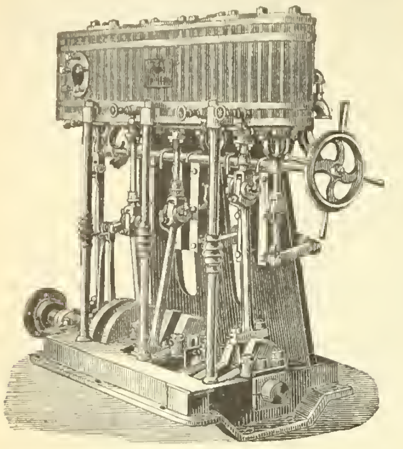

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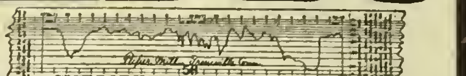

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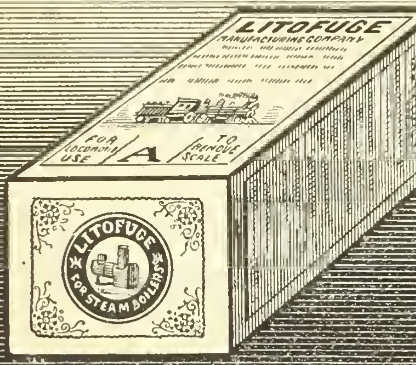

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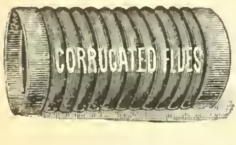

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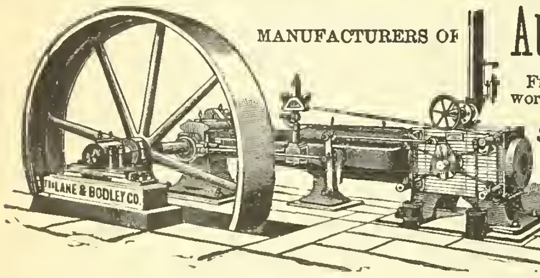
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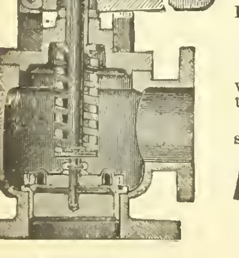

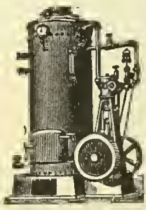

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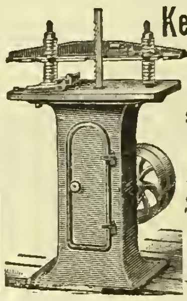

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THE ENGINEER.

NEW YORK

NEW SERIES, 1883, 1888. VOL. XIX. **No. 8**
TENTH YEAR OF PUBLICATION.
STEAM ENGINEERING, APPLIED

$2.00 PER ANNUM. - SINGLE COPIES, 8 CENTS.
April 12, 1890.
MECHANICS, AND THE ALLIED ARTS.

THE WORTHINGTON MARINE PUMP ADMIRALTY PATTERN.

THE efficiency of the Worthington steam pumps is so marked that they have been adopted on English ocean liners, and many of them are now in use, notably on the '*City of Paris*,' where they were not properly placed, and on the '*Majestic*,' the newest vessel intended for fast traffic. This style of pump was designed to meet the demands of the English Admiralty, and it also conforms to the regulations of our own Bureau of Steam Engineering. As regards the machine itself nothing remains to be said which the engraving does not tell. It is so compact that it will go into a space which cannot be used for any other purpose, and it is so accessible that if a man can get in front of it he can get all round it, in an engineering sense, and it is so strongly made that it is safe to use it against 250 pounds pressure if need requires. So long as steam is supplied it will continue in action (if there is any water to remove), requiring no attention or supervision beyond that necessary to all steam machines. The pumps under test have shown an efficiency of 96 per cent. If necessary, a hand attachment can be supplied at a slight additional cost. The compact form, light weight, quietness of movement,certainty of action, and durability of these pumps, have created a large demand for them both at home and abroad. This pattern of Worthington Marine pump can be used as an independent boiler feeder with special advantage where high steam pressure is carried,in connection with triple and quadruple expansion marine engines. It is also well adapted for bilge and fire service where excessive weight is objectionable and where but limited space is available. This pump is made in a variety of sizes, from 24 gallons per minute to over 600 gallons per minute, and is particularly suited to steam yachts where space is valuable. Made by Henry R. Worthington, N. Y.

◆

SATINET is the material from which the $50-suits-sold-for-$12 ready-made clothing is manufactured. It has a warp of cotton to give it strength, and the woof is filling, so-called, made of woolen rags wound up. The material has then printed upon it, very much in the same way that calico is printed, designs in imitation of the standard woven woolen goods of high grade. The material is used not only for men's wear, but for making women's cloaks, ulsters and similar garments. The stuff costs about 20 cents a yard, and wholesale dealers in ready-made clothing make and sell a very respectable-looking pair of trousers from it at about 75 cents. Full suits can be retailed at about $6.

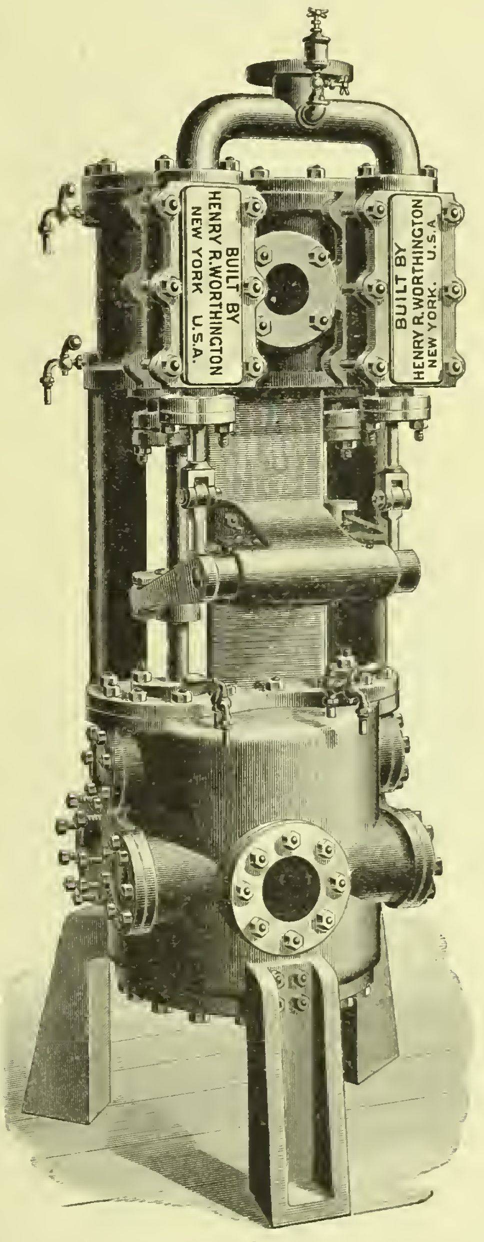
◆

MANY letters of condolence which have reached us are obviously written for publication, but, while we acknowledge the thoughtfulness of the writers, we shrink from further publicity in this matter, and consider that we have no right to occupy more space with our private affairs.

◆

NOTHING whatever is known as to the character or extent of the accident to the '*City of Paris*.' When the Board of Trade reports are made public we shall publish them. Until that time speculation is worthless.

WHERE an engine merely varies in speed without racing, it would appear good practice to let the pencil of the indicator run upon the paper cylinder for one minute, during which the revolutions are counted with a good watch. The diagram thus obtained will be a broad, thick line, perhaps as wide as $\frac{1}{8}$ inch, and blackest at the mid breadth of the line. A mean figure traced through the average central band of blackness would give very closely the mean power of the engine as running for one minute at the observed revolutions. Such a diagram, indeed, will be more probably accurate than any single figure taken at the speed counted during 15 seconds. Clean, sharp, single, fine line diagrams, are all very well to look at, and with steady running cotton mill engines such diagrams will be taken off even when the pencil is allowed to run several times around the card, but for engines worked without a governor, or governed only through the throttle valve, and not over burdened with flywheel inertia, the use of the indicator requires special modification, and there seems no reason for not letting the instrument work out its own averages in the way described for a full minute of revolutions.—*American Machinist.*


BUILT BY HENRY R. WORTHINGTON NEW YORK U.S.A.
BUILT BY HENRY R. WORTHINGTON NEW YORK. U.S.A.

THE COUNTRY PROSPEROUS.

NOTHING shows the condition of legitimate trade and manufactures better than the condition of illegitimate trade—that is, the stock market,where men buy and sell things they never had, produce nothing, and bet on the rise or fall of certain securities. A financial article in a daily paper says :

> "The dullness of business on the Stock Exchange, which has prevailed now for more than a year, shows no signs of abatement. The brokers, whose bread and butter depends upon the amount of their commissions, of course complain most loudly, but their dissatisfaction is shared by others, to whom operating in stocks is an amusement and an occupation, and who feel very much as children do when they want to play a game and can find nobody to play it with them. Seats which were selling ten years ago at $30,000 and more, now bring only $20,000, and, it is said, a little less, with a falling rather than a rising tendency."

This is encouraging to producers, and shows better than anything else that the public have stopped gambling and gone to work.

◆

STEAM has wholly or almost entirely changed the duties of the officers of the fighting ship. Ships no longer have sails to set, trim, or take in. They are run by steam engines, of which the fighting officers know nothing. The engineers drive the ship, they turn her, get up anchor, look after the preservation of the hull, patch holes made by shot, work the pumps, and they are the electricians who light the ship; they load, aim, and fire the cannon, (all by machinery and electricity), they load, aim and discharge the torpedoes, and yet naval surgeons get better pay and are ranked higher. It is true that the captain or a deck officer says when each of these things shall be done, but there is no reason why the engineers should not learn navigation, and so become fitted for deck officers as well as for their present duties. In the days of sails it was thought necessary that every naval officer should crawl in through the hawse pipes to this extent, that, although ranked on entering the Navy as a midshipman, he had to learn and to do a seaman's work, and, in fact, all the work of the ship. Now about all the work of the ship is done by a distinct class of men. It is not unlikely that in the future the officers of the Navy will have to crawl into the ship through the coal chutes—that the Admirals will first serve as cadet engineers, and that the engineers will be promoted to the cabins, or, in other words, that the requirements of the service will abolish the distinction between the engineer corps and the so-called regular line.

◆

A YOUNG man in England recently ran 20 miles in 1 hour, 52 min., 51 seconds, which is much quicker than anyone else ever did, but when this is told that is all there is to be said, unless to ask why he did it. No one can perform such a task without permanent injury, while the present gain amounts to but very little. Sometimes it amounts to nothing, for men do it to "break the record." John Jacques Richter said that some men spent the first part of their lives in laying up sorrow for the last part, and young men like the one mentioned above seem to be an instance of Mr. Richter's sagacity.

◆

ONE bushel equals 1.284 cubic feet.

PETROLEUM AS FUEL USED SIXTY YEARS AGO.

Although looked upon as recent, the use of liquid fuel is not by any means new. It is claimed that so long ago as 1830, H. Pinkus made use of hydrocarbon in conjunction with streams of vapor for steam raising purposes, and from that time down to the present, engineers and inventors have been constantly exercising their ingenuity in the same direction.

Among the efforts to introduce this system, we may mention Richardson's petroleum furnace, as well as Bridges Adams, which was for many years in Woolwich Dockyard, while in 1868 the Government allowed Wise, Field, and Aydon's system of operating petroleum by the aid of an induced current, to be applied to a marine boiler on board one of their steam yachts. The same system had also at that time been applied to a Cornish boiler in London. The Admiralty also tried an invention of S. E. Crow, but nothing practical resulted, while in the same year Dorsett's petroleum furnace was fitted under the boiler of the Ss. '*Retriever*,' 90 h. p. and 500 tons burden. Some successful runs were made with the '*Retriever*,' but so far as this country was concerned nothing seems to have been done further. One reason for this change may have been the fact, that directly the demand was made for the class of liquid fuel used, and which previously had been almost a drug on the market, the prices went up to such an extent as quite put the idea of any profitable use of the oil as fuel out of the question.—*London Machinery Market.*

[This seems to be a natural consequence, and one that we have always put forward.]

◆

The steam trial of the gunboat '*Concord*,' which will take place soon, will be watched with much interest to see how her performance compares with that of the '*Yorktown*.' The two vessels were built on identically the same plans, except that there are some minor differences in the machinery. The closed ash pit system of forced draught is used on the '*Concord*', while the closed fire-room system is used on the '*Yorktown*.' There is also a difference in the air pumps, the '*Yorktown*' being fitted with a pump designed by the Cramps, while the '*Concord*' has a Davidson pump, and the closed ash pits are expected to give the '*Concord*' still more of an advantage, so that she is expected to make a better horse-power showing and consequently greater speed than the '*Yorktown*.' Her contract requirement is 3,400 h.p., 400 more than that of the '*Yorktown*, and 8 more than the '*Yorktown's*' record of 3,392 on her trial.—*N. Y. Times.*

With all these differences how can there be any comparison with the '*Yorktown*?' "My gun," said Pat, "is just the same as master's, only it has a different lock, stock and barrel."

◆

There is a prospect of another international yacht race this summer and Capt. Payne says some one ought to build a new boat. Even assuming that the '*Volunteer*' should go in, there is no good "trial horse" to help in getting her into fix. You can't tell whether you are improving a yacht or not unless you have some close competitor to test her with. The New York Yacht Club should not depend upon any boat three years old. Three years makes a great difference in the science of naval architecture. We on this side have improved a good deal in three years, and there is no telling how much they may have advanced in England. They have been making their boats more powerful and have added the center-board. That new boat of Mr. Jameson's is not to be sneezed at, and if we should be obliged to cope with a craft of that description we ought not to allow her to have the advantage of three years over us."

◆

In Scotland 21 new vessels have been fitted with quadruple-expansion engines.

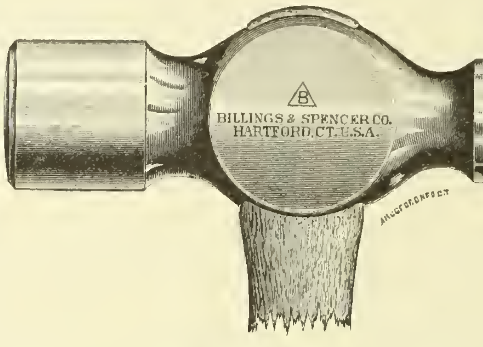
BILLINGS' BALL-PENE MACHINISTS' HAMMER.

We received recently the letter appended:

"We send you prepaid, by express, one Billings' Ball-Pene Machinists' hammer for Mr. Egbert P. Watson. We do not know that he is wielding the hammer as much as he did in days gone by, but we do know that he would like to take one of our hammers in his hand, therefore we send it with our compliments. Will Mr. Watson please criticise this product of ours? We know that his long experience in its use qualifies him to give us points we may have overlooked. We do not assume to know it all."

THE BILLINGS & SPENCER CO.
Hartford, Conn. C. E. BILLINGS, President.

If Brother Billings does not know pretty much all that a hammer should be we do not know who does, we cannot give him any points that he is not already in possession of. Certain qualities are essential in a good chipping hammer, and these are all embodied in the tool before us. All men's hands are not alike in size or shape; the big-handed man can take a handle that the small-handed man cannot hold comfortably, but as handles made for the trade cannot be of every size, it might be well to leave them large enough for dressing down, putting a small label on the handle stating that fact. No matter what handle is put in machinists are so notional that they will do something to it, if it is only to shellac it noon-hour. If the handle is too small, however, it works blisters on the hand in a short time, and if it is too large it tires the muscles of the hand to grip it.


B
BILLINGS & SPENCER CO.
HARTFORD.CT.U.S.A.

As to weight, hang, style, and general finish, the Billings hammers surpass any that we have seen. They are made of the best tool steel and are sure to meet with rapid sale wherever known. We think some of looking up a job on purpose to use this hammer before us, otherwise it will be devoted to the ignoble purpose of driving nails in our wood-shed.

◆

The advantage of public ownership of natural monopolies is beginning to be appreciated. The owners of the electric-lighting companies have perceived the trend of public opinion. One of them, in a recent work upon the subject, has enunciated the astounding principle that electric lighting, above all other industries, "is the field for private monopoly." But this proposition is far from being generally accepted. Theory as well as practice points to an opposite direction. In view of the general satisfaction expressed by citizens of those cities operating their own electric lighting plants, the day is rapidly approaching when cities will own their respective plants and thus reduce the cost of lighting to a minimum.—*The Independent.*

◆

There is urgent need of stringent laws in this country to prevent testators from wronging their kindred. Read this:

The will of the late ——— ——— of Bergen county, leaves to his wife, in lieu of a dower, the house and farm of forty-four acres as a home for herself and her unmarried daughters. To his son he gives $1,000. The income of the rest of his property, with the exception of $500 a year to his widow and $200 a year to each of his four daughters, is to be given to the American Swedenborg Printing and Publishing Company, of New York. The estate is variously estimated at from $100,000 to $250,000.

Obviously, the thing for the principal beneficiaries to do is to give the money right back to its lawful owners. They cannot find anything in the teachings of Swedenborg to justify them in keeping it, but they will, all the same.

LITOFUGE.

This is the name given to a boiler purge which has been in the market for some time and has been found exceedingly prompt and satisfactory in its action, without any injury to the boiler. The name is a significant one, and means literally "stone-chaser," from *lithus*, stone, and *fugis*, to flee, and the company assert that this is exactly its action on boiler-scale, it chases it out of the boiler. A board of Naval Engineers appointed by the Government give it a high character, as the result of an extended trial on a Government tugboat, concluding with these words:

"We afterwards made careful and practical experiments with the Litofuge, in order to ascertain its action upon the material of which boilers are made, resulting in the conviction that not only is it free from any injurious effect, but that it really acts as a protection to the metal. And we recommend it for purchase and use in the Naval Service as required by Act approved July 18, 1861."

Litofuge does not dissolve the scale but simply detaches it, so that it can be removed bodily from the boiler through the hand-hole plates. Many marine engineers with whom we are personally acquainted, have used Litofuge with great success and testify to its practical value, so we feel quite safe in reccommending at least a trial of it, as per advertisement elsewhere.

◆

The ceremony of fastening the last rivet by the Prince of Wales in the Forth Bridge was an occasion of much fuss. The labor was not arduous. The Prince did not put it through the plates it was destined to secure, and then close it with a hammer. The rivet was of German silver, was fastened by a hydraulic machine, and all he had to do was to turn a key. When the train arrived at the spot where this ceremony was to be performed, Sir William Arrol got out of the royal coach and brought the rivet in for his Royal Highness to inspect. The rivet was about two inches long. On its head in blue enamel was the legend: "Last rivet put in by H. R. H. the Prince of Wales, March 4, 1890." When this had been approved of a silver key was handed to the Prince, which he was told he might retain as a memento of the occasion. The handle of this key contained on one side an enameled picture of the bridge, and on the other the inscription: "With this key, on March 4, 1890, His Royal Highness the Prince of Wales fixed the last rivet in the Forth Bridge."

Armed with his new key, the Prince got out in the wind storm, the rivet was put into place by a youth on a scaffolding over the edge of the rail, and while great men hovered anxiously about, Albert Edward put his silver key into place, and, with his kid-gloved hand attempted to turn it. The hydraulic machine, however, was obstinate and would not work, and it was only after Mr. Arrol had turned it almost on that the Prince was able to complete the job. Then he went back into his Pullman car and received the congratulations of the greatest engineers of four countries upon the success of his achievement.

Hi! hi! hi!

◆

The House by a unanimous vote passed the bill providing for a bridge across the North River at New York. The structure is to be seven miles in length, and its construction is to proceed under the direction of the Secretary of War. The list of incorporators headed by Jordan L. Mott and Engineer Lindenthal, has already been printed. It is estimated that the stupendous enterprise will cost between $30,000,000 and $40,000,000; it will have at least six, and probably eight tracks, and besides affording accommodation for railroad trains will also be equipped for vehicles and foot passengers. The bill was sent to the Senate, and it is believed will soon receive the approval of that body.

◆

The Series on American Engineers is not discontinued, but merely omitted from want of room in the current issue.

GLUE.

THE raw material, or the animal skin from which we obtain glue consists of two parts; the upper layer, termed the epidermis, which is useless as a glue-making material, and the under layer, or dermis, which constitutes the true skin, and it is this which we require for glue manufacture. The portions of fat and flesh which often adhere to this, and are named the adipose tissue, are also entirely useless, and must also be got rid of before we proceed. All the animal trimmings are useful, such as the heads, the ragged edges, the ears, the tails, feet and other pieces. It must also be borne in mind that the older the animal, the better will be the quality of the glue obtained. It is therefore advisable to keep the pieces of ox by themselves, as well as the pieces of sheep by themselves, and the pieces of hog, hare and rabbit skins, by themselves, and to give a separate boiling to each lot, as the smaller the animal the less solid the glue. Thus different qualities are obtained, which renders them more especially fit for certain operations and for certain classes of trade. The size is used in the manufacture of paper, while the glue may be used by carpenters, joiners and in numerous other manufactures.

Glue is composed of:

	Per cent.
Carbon	49.1
Hydrogen	6.5
Nitrogen	18.3
Oxygen and sulphur	26.1

The composition of it makes it nearly analagous to that of skin; in fact, glue and its modifications of isinglass, jelly, crude glue, etc., are supposed by many to really have the same chemical composition, but different physical characters, just the same as with the starches and sugars, etc.—*Unknown Source.*

◆

A NOVEL fishing job has been going on at a well near Tidioute, Pa. Experts have been at work at the hole a long time trying to remove a set of tools from the depths thereof, but without success. A patent photographic apparatus was lowered down the hole for the purpose of getting a picture of the situation of affairs there, but before the bottom was reached the rope gave way, and the instrument, like McGinty, went to the bottom of the hole and remained there. The lone fishermen are now trying to catch on to the camera.—*Bradford Era.*

◆

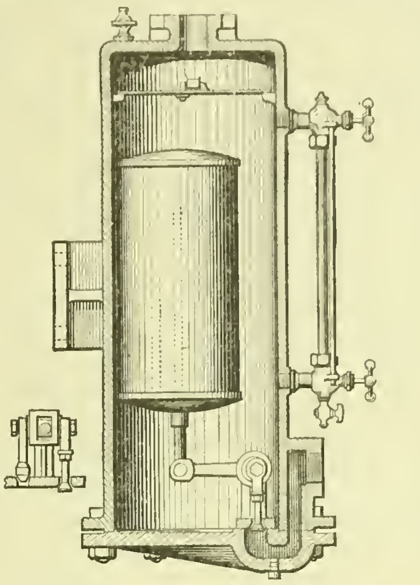
THE censure that has been passed upon the captain of the '*Adriatic*' is not warranted by the facts. Capt. Roberts did all that was required of him by the laws of humanity or the customs of the sea in offering to take the passengers from the disabled steamer. The question of saving a ship is not a question of humanity, but a question of profit. When it was proposed to him to abandon his voyage and turn back with his passengers for the purpose of enabling the '*City of Paris*' to complete her voyage in the opposite direction, the question for him to decide was whether he could justify himself to his owners for doing this. Upon this point his owners are the only judges and they do not express any dissatisfaction. The wishes of a passenger on a disabled ship bound for Liverpool as to the direction in which he prefers to go cannot outweigh the wish of a passenger on board a ship not disabled and bound for New York in the mind of the captain of the latter vessel. He is engaged in executing a contract to take his passengers to their destination, and while he may properly delay the execution of this contract in order to save life, he cannot properly delay it in order to save another steamer.—*N. Y. Times.*

◆

THE difference in hard coal tonnage between a cold and a warm winter, says the *Coal Trade Journal*, is about 2,580,754 tons. In an ordinarily cold winter New York uses nearly six million tons of coal, of which a little more than two million are bituminous and three and a half million are anthracite.

FOGARTY'S IMPROVED STEAM TRAP.

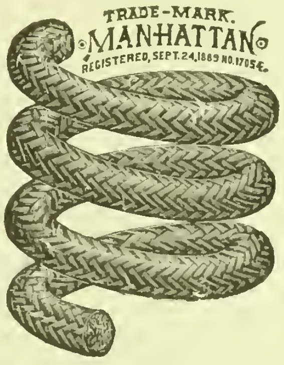
JAMES H. FOGARTY, 97 Liberty Street, New York, has recently made great improvements in the construction of his steam trap, whereby it is not only increased as to the amount of work it will do, but the cost of construction is decreased, so that he is enabled to offer them at a less price than before. Mr. Fogarty's trap is exceedingly simple in construction and wholly positive in its action. It does not depend upon expansion or contraction of metals to operate it, and will discharge cold liquids as well as hot; it has the fewest possible details, which are very sensitive and so arranged as to give a much larger discharge area for the condensed water than some traps, consequently it will do more work. This is found to be the fact in sugar refineries, dye works, and all other places where traps are used, one of Fogarty's traps doing the work where three or four of other makes would be needed. Price lists can be obtained by addressing the manufacturer and inventor as above.



◆

MANHATTAN PACKING.

IN our notice of these goods in the last issue we stated that they were made from best quality of jute which was thoroughly incorporated with plumbago. This is an error, as the packing is made from a combination of different fibres, and is peculiar, in that each strand is thoroughly lubricated before it is braided, and is guaranteed to outwear any jute or hemp packing made. We regret the error as the manufacturers have built up a reputation for their goods on the basis of the material used and naturally object to having misstatements made about them. Send for a sample as per advertisement in back.


TRADE-MARK.
MANHATTAN
REGISTERED, SEPT. 24, 1889 NO. 17054.

◆

THOMAS FITZIMMONS, inventor of the celebrated clock described some months ago in THE ENGINEER, is prostrated over the intelligence that his invention was wholly destroyed by fire while on exhibition at Owego, N. Y. He valued the mechanism at $15,000, and had refused an offer of $7,000 for it. The clock was insured for $5,000, but this does not pacify the inventor. It took him four years to build it, and he says he can never build another.

◆

YOU have doubtless heard of Herr von Bismarck, the great German statesman! Well, he says things sometimes worth heeding. This is what he said recently, referring to the Socialist strikes. He said "that they were not the worst danger, for they would pass over. The saddest possibility for workers was the chance that the strikes would so dishearten employers that they would lose all desire to continue business."

This is worth thinking about.

WIRE ROPE.

A WIRE rope manufacturing company gives the following hints: There are two kinds of wire rope manufactured. Ropes with nineteen wires to the strand are more pliable, and are generally used as hoisting ropes. Those with twelve or seven wires to the strand are stiffer and best adapted for guys, ferries, rigging and transmission purposes. Wire ropes are made of six strands, laid about a center of hemp or wire, the former being more pliable, and wearing better over small pulleys and drums.

Wire rope is as pliable as new hemp rope of the same strength. The greater the diameter of sheaves, pulleys and drums, the longer the rope will last.

For safe working load, allow one-fifth to one-seventh of ultimate strength, according to speed and vibration. Speed increases the wear.

Wire rope must not be coiled or uncoiled like hemp rope. When not on a reel, roll upon the ground like a wheel to prevent kinking.

To preserve wire rope, cover it thoroughly with raw linseed oil, mixed with vegetable tar. This mixture forms a protecting surface, and preserves it from undue wear.

To preserve wire rope under water or under ground, add one bushel of fresh slaked lime to a barrel of mineral or vegetable tar, boil well, and saturate the rope with the mixture hot.

Galvanized wire rope should never be used for running rope. One day's use will wear off the coating of zinc, and the rope will soon begin to rust.

Too much care cannot be taken with the pulleys, sheaves and drums over which ropes are run. The grooves should be lined with well seasoned blocks of hard wood set on end, rubber, leather or some soft metal. Thus the life of the rope will be greatly lengthened and greater adhesion secured than when the rope is operated over smooth and hard surfaces.

Iron ropes, operated under proper conditions, will give perfect satisfaction when the work to be done is not too heavy. Steel ropes should be substituted for iron when lightness is required or when a greater strength becomes necessary. The object in substituting steel for iron is to decrease the wear rather than reduce the size of the rope. In ordering, the purpose for which the rope is to be used should be stated, also what kind of center is desired, whether hemp or wire, and advice will be given.

◆

MR. J. N. LAUDER, superintendent of rolling stock of the Old Colony road, has been preparing to test the principle of compounding on one of his standard passenger locomotives. Several months ago Mr. Lauder secured the services of Mr. F. W. Dean to work out the details involved in his plans. In his standard locomotives, Mr. Lauder has probably come as near to the limit of economical service as anyone in this country, so far as the American type is concerned, and a comparative test on his road will, therefore, be of the greatest value in determining the relative economy of compounding. In order to make the tests strictly comparative, Mr. Lauder simply changes one of his standard engines into a compound. The high-pressure cylinder is 20×24, the low-pressure 28×24 inches, the high-pressure cylinder is steam jacketed, and the pipe leading to the low-pressure cylinder passes through the smoke arch, and is specially protected against condensation before it enters the arch. High-pressure steam can be admitted (through a reducing valve) to the low-pressure cylinder at starting or whenever desired. Instead of an automatic arrangement by which the compound action must begin when the drivers have made part of a revolution, this feature is controlled by the engineer, who can use direct steam in both cylinders at any time, and for as long as he pleases.—*Master Mechanic.*

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

TRIUMPHS OF ENGINEERS.

Editors ENGINEER :

In the issue of March 15 I notice a communication by "Americus," in which, after referring to the Ericsson articles in *Scribner's Magazine,* he treats his readers to some interesting history, showing how John Ericsson was educated, his great proficiency in study and in achievement while yet a mere boy. The point also is well brought out that John Ericsson's parents were worthy of such a son.

I think that the next author who compiles a book called "The Boyhood of Great Men" will build unwisely and unjustly if he choses to pass by the bright examples and exemplars he might find among the men distinguished in industrial design and great mechanical achievement. And men of this stamp are not confined to the old world, though we heartily recognize the fact that they have had their biographers and historians worthy of the character, the deeds and the fame of the discoverers, the inventors and the great mechanics of other times. Did I say "great"? Indeed, yes! And why "great"? Does it require "the pomp and circumstance of war" to invest a man with greatness?

Let us concede all that can be reasonably asked by the logic and custom of history and tradition, and that is much to concede. The author of "The Decline and Fall of the Roman Empire" tells us that "the Emperor Trajan was ambitious of fame, and, as long as mankind shall continue to bestow more liberal applause on their destroyers than on their benefactors. the thirst of military glory will ever be the vice of the most exalted characters."

But the second century of the Christian era was an age of war; how is it in later times? Justin McCarthy, in his "History of Our Own Times," finds subject matter for a chapter on "Science and Speed" as being coincident in England with the opening of Queen Victoria's reign. He says this period of that sovereign's reign must have an abiding-place in history, because of the locomotive, the steamship and the electric telegraph.

While the author does not say that the man who did so much for "Science and Speed" will be neglected by historians, he tells us that a very distinguished writer and author refuses to countenance the spirit which would rank such inventions and improvements as those mentioned, with the genuine triumphs of the human race, and has gone so far as to insist that there is nothing in any such—in the steam-engine, locomotive and telegraph—which might not be expected from the self-interested contrivings of a very inferior animal nature." There's gall for you!

The "distinguished, etc.," must be a British Tory, as the rate of progress of that genus is about one standard inch in one hundred standard years.

Mr. McCarthy, in his history referred to previously, aims to be impartial, conscientious and sensible.

He sees fit to remark that "there will always be natures to whom the philosophy of contemplation must seem far nobler than the philosophy which expresses itself in mechanical action."

Very well; if such natures demand a high degree of respect and admiration for, let us say, that philosopher who solved one of Nature's sublime problems, they are welcome to it.

A great discoverer was Isaac Newton, the philosopher, who tells us that "Industry is genius." The law of gravitation is a grand subject for contemplation, yet this old world had traveled in its appointed orbit up to the year 1682 before its dwellers were aware of the principle which governs the planetary system.

It was a majestic triumph of human genius—"industry," rather, that famous old knight of labor, Newton himself, would say.

Let us compare for a moment what may be called the possibilities and the realized results of great "discoveries."

In this present year of grace we have a reasonable conception of Columbus as a contemplative navigator, as we certainly have of the measure of his fame.

Have we a just idea of the discoverers and the creators of the steam engine? How much did those men lack of the character of philosophers? In what degree was their "animal nature gratified" by their great sacrifices, by most toilsome days and nights of weary study and experiment? How much greater than a king would John Ericsson have been at that first trial of locomotives in England 61 years ago had his steam blast been in the smokestack! George Stephenson's, was there, and, though Ericsson's little "Novelty" made as good time as George's "Rocket," a few mishaps occurred at the trial, and Stephenson won the prize by a scratch.

It was the Briton and the Swede in a neck and neck race for supremacy. The one a draughtsman of chalk and charcoal lines and sketches, the other accomplished in all the lines of industrial design.

Stephenson deserved his reward. No one can read the life of that humble philosopher and great engineer without feeling strong admiration for the man. An uphill struggle was his for many weary years, and if his fortitude and courage is not true nobility of character, where can we look for the qualities which form such a standard?

That the steam engine and the locomotive is not the creation of any single brain we do not forget.

James Watt was honest and very modest in his claims. He said he had taken up the machine as shown to him, and by hard work and many experiments "improved" it. But that is far too modest. Before he touched the Newcomen engine James Watt was an inventor. He became afterwards a greater one. By means the most simple his experiments were conducted. He was working busily at other things about the time his master-thought occurred to him.

How to condense steam without cooling the steam cylinder, was the burden of his mind that Sunday afternoon in his stroll upon Glasgow Green.

Like an inspiration it came to him; why not use a separate chamber?

The man who was to be his partner in business a few years later had also studied the same problem.

Matthew Boulton and our American philosopher, Benjamin Franklin, were both interested in a steam engine model, and as friends, were consulting each other as to the better method of condensing. Benjamin counsels Matthew to go on with the "experiments." There is no name connected with the mechanical events and glories of this interesting period, which deserves more conspicuous and honorable mention than that of Matthew Boulton. Watt is the father of the condensing engine; but the man who stood by the new motor through evil and through good report, the man who sustained Watt against the harsh environment of all but crushing difficulties, the man who said he "could not agree to build engines for three counties, but would build them for the world," this enterprising and self-reliant and generous man of business was Matthew Boulton. A very large manufacturing plant is yet established on the ground where those famous partners commenced work together one hundred and thirteen years ago, and though no one of their descendants figures in the business, the name of "Boulton and Watt" is still retained.

Retained in a more humble manner is the name of the great Swedish engineer in his native town of Langhans-hyttan, province of Wermland, Sweden, where he was born, July 31, 1803. Upon the house in which he first saw the light is the inscription "In this house John Ericsson was born." Better than a volume of panegyric is that simple sentence.

I trust the conductors of your journal will go on calling the muster-roll of American engineers of distinction and well-earned fame.

D. W. LANIGAN,

Shell Lake, Wis.

◆

A POWERFUL NEW FIRE BOAT.

THE '*New Yorker,*' designed by William Cowles, of this city, is of the following dimensions:

Length over all	125	5
Length on load water line	115	0
Beam, load water line	25	2
Extreme draught	10	0
Depth	14	0
Displacement	351	tons.

The hull is of steel throughout, and the bulkheads and frames are so arranged as to give great stiffness. In fact, the hull is a cross between that of a tug and a torpedo boat and includes the desirable qualities of both. The '*New Yorker*' will be driven by a triple-expansion engine with cylinders 15, 24 and 39 inches in diameter and 24-inch stroke. The steam is generated in two Scotch boilers and will be worked at a pressure of 150 pounds to the square inch. The '*New Yorker*' has two propellers, one abaft the other. The after one is hung clear abaft the rudder and is geared to the main shaft, so that it swings with the rudder. The vessel is steered by steam, of course, and the rudder with this steering propeller can be thrown hard over in eight seconds. She can, therefore, be steered through the most crooked channels.

The chief interest of the boat lies in her pumping capacity. The '*New Yorker*' has four sets of vertical double-acting flywheel pumps. Four of them are of the La France type and four of the Clapp & Jones. The differences in detail between the pumps are not worth mentioning, for both are plunger pumps operated by steam. The steam cylinders are 16 inches in diameter, and the water cylinders 10. The stroke is 11 inches.

The boat has four fixed towers from which water may be thrown. At least one of these nozzles will be five inches in diameter and the others four. With the power of all the pumps concentrated on the one five-inch nozzle a stream of solid water can be thrown to a distance of 500 feet on the level. But that does not convey an adequate idea of the power of the stream at short range, for it is guaranteed to bore its way through any brick wall alongshore, not excepting even such walls as those of the Williamsburg sugar refineries. People who have seen big fires in alongshore buildings and lumber yards have observed that even the most powerful streams of the ordinary engines at times were futile, for the water was decomposed by the fierce heat, so that the gases seemed to aid the flames. But with a five-inch stream bursting its way through walls and floors or stacks of flaming lumber the work of the firemen will soon be over. In the pipes leading to the nozzles there are twelve 3½-inch hose connections and two 6-inch gates or hose couplings. On each of two side headers there are six 3½-inch hose couplings and one 6-inch gate, and on two after headers there are four 3½-inch hose couplings and one 6-inch gate. The boat is not alone available at a fire alongshore, therefore, for a line of 3½-inch hose could be laid from her, if at the foot of Dover Street, for instance, up to the *Sun* building.

The house on deck is built of iron and roofed with asphalt. There are six traveling screens 4½ feet high above the rail and six feet long, which can be moved to any part of the rail, so that the firemen can have something to hide behind when fighting fire on a pier or other structures at the water's edge. With these screens around the bow of the boat she could run right up to a blazing pier shed. The screens are made of two sheets of metal with an air space between, so they will be a long time getting uncomfortably hot on the inside. There are holes in them for the firemen to look through, and larger holes through which to direct streams of water.

The pilot-house is protected by iron shutters that have peep holes in them. Another very ingenious device for protecting the men when fighting fire at short range is the system of lawn sprinklers. At suitable intervals fore and aft are placed stand pipes that have on top the small curved revolving arms familiar about lawns in summer. The valves in these pipes are controlled from the pilot house, so when the screens or the deck get too hot or the air too full of smoke the water is turned on and everything wet down fore and aft.—*N. Y. Sun.*

◆

THE Frontier Iron and Brass Works, Detroit, are building two triple-expansion engines, 20, 32 and 54 by 42, for F. W. Wheeler & Co., West Bay City. One triple-expansion engine of the same dimensions, and one fore and aft compound engine 24 and 46 by 42, for James Davidson, West Bay City, also two triple-expansion engines 21, 34 and 56 by 42, for two steel steamers being built by F. W. Wheeler & Co., to run between New York and Newport News, Va.

◆

OLD drawings, made between the years 1826 and 1840, prove beyond the shadow of a doubt that compound engines with 70 lbs. to 80 lbs. steam were working on the Rhine and Meuse so long back as sixty years ago, and also that many of what are generally supposed to be be modern improvements, such as forced draught, hollow shafts, stepped floats, and balanced rudders, were practically applied only a few years later.—*London Engineer.*

◆

CAPTAIN GEORGE DREVAR, well known as an experimentalist in life-saving apparatus at sea, was drowned in a lake in Centennial Park, at Sydney, January 1. Curiously enough, the accident happened while he was engaged in experimenting with one of his inventions.

◆

THE New York Steamship Company, organized to run a line of steamers between this port, Maine and the Provinces, are fitting up spacious offices at 63 Broadway.

OSCILLATING vs. BEAM ENGINES.

In an article on the late Horatio Allen in the *Railroad and Engineering Journal*, N. Y., we find this reference and comparison:

"Mr. Allen was always a great advocate of oscillating cylinder engines for side-wheel steamships and in 1867 he wrote what he called 'A Statement of Facts and Considerations in Reference to Beam and Oscillating Engines for Marine Side-wheel Steamships,' which was afterward published in a pamphlet. In this Mr. Allen compared engines with 85-inch cylinders and 8 feet stroke, and claimed that the room occupied by the oscillating engine compared with the beam engine is 8,500 cubic feet for the one and 14,750 for the other; the weight 138 and 152 tons respectively; the number of parts through which the power is transmitted from the piston to the crank is three for the oscillating engine and nine for the beam engine; the number of parts which must be constructed in true line and relation to each other is three for the oscillating and six for the beam engine; the number of bearings and their brasses to be kept in proper adjustment and lubrication is five for the oscillating and thirteen for the beam engine. He also explained that the structure through which the power was transmitted from the cylinder to the crank-pin would be much stronger and more substantial, and the strain on the bottom of the vessel less with the oscillating than with the beam engine; the weight, which comes to a state of rest in passing the centers, is 7½ tons in the one engine and 30 in the other; the valve-gear of the oscillating engine, it was admitted, has more parts than that of the beam engine. It was also claimed that all the journals of the oscillator are as accessible as those of the beam engine, that the first could be balanced by cast-iron buckets on the wheel as perfectly as the latter is by the weights at each end of the beam.

The '*Adriatic*' had oscillating engines, and Mr. Allen applied his valve-gear to them, which consisted of large conical plug-valves. These were moved by a mechanism which first lifted the valves and then turned them, which, it was supposed, would prevent them from jamming. There was considerable difficulty in getting them to work satisfactorily. This caused much delay and involved a heavy expense. Some part of the gear broke down on a trial trip, and the valves were finally taken out and others were substituted for them. As there was great rivalry at that time between the Cunard Line—which was owned by Englishmen—and the Collins steamers, which were owned by Americans, this experimental valve-gear attracted a great deal of attention, and was the subject of much criticism.

◆

A SANGUINE person advertises as follows in a daily paper:

> "To collectors, lovers of wealth in heirlooms, antiquated relics, connoisseurs, etc.—A copper Spoon Mould, handed down from five generations, showing the slow process of manufacturing spoons in 1723, taking at that time about 24 hours to make one dozen spoons. At the present date, by the improved way of pressing the silver plate they can be made at the rate of a dozen in one minute. The greatest curiosity of its kind of the age. Will be sold for $50."

No doubt some person equally as silly as the advertiser will buy it.

◆

AN English contemporary mentions an instance of a new large steam engine that gave trouble from a hot crank-pin. Finally the engineer in charge measured the pin, and found it one sixteenth of an inch oval. The journal referred to remarks: "It is easy to see that the lathe in which the pin was turned was in fault. It is quite likely that the turner was more or less incompetent." One-sixteenth of an inch oval! We do not believe the conclusions arrived at can be successfully questioned.—*American Machinist.*

Probably not, but how can a man fit a brass to a pin one-sixteenth oval?

AMBERGRIS.

THE word ambergris is French, and signifies gray amber. The scientific explanation of ambergris is that it is the product of some disease in the sperm whale analogous to gall stones. It is found sometimes in the intestines, but more frequently floating on the surface of tropical seas, in masses which have a speckled-gray appearance.

The best quality of ambergris is soft and waxy, but not uniform in color. The streaky specimens are preferred. It is opaque and inflammable, remarkably light as to specific gravity, and rough to the touch.

Most of it is found near the Bahama Islands, but also at the Moluccas and other parts of the Indian Ocean, off a portion of the coast of South America, and sometimes floating on the Atlantic Ocean.

The essential characteristic of ambergris is its powerful and peculiar odor. It is so peculiar that art has never been able to imitate it, although the scarcity and enormous price of ambergris has lent every stimulus to invention. It is so powerful and diffusive that the very minutest quantity is perceptible in the most fragrant perfumes.

The chief component of ambergris is a fatty matter called ambrein, which is obtained by boiling in alcohol. This ambrein —and there is said to be about 85 per cent. of it in the best ambergris—is what gives it its value, for it is in this ingredient that the perfume lies.

There is another peculiarity ascribed to ambergris, and that is the power to exalt the flavor and perfume of other substances with which it is brought into combination. Thus, a grain or two rubbed down with sugar is often added to a hogshead of wine, giving a perceptible and, what is considered by some, an improved flavor to the whole; a small particle of ambergris added to other perfumes is found to exalt the odor of the blend.

Ambergris is too dear to use alone, and it is so dear that it is one of the most adulterated articles known to chemists. It is adulterated both by those who export it and in the countries in which it is used.—*Chambers' Journal.*

◆

THIS is for lady readers of THE ENGINEER, of whom there are many: "An easy method of bronzing articles, such as metal chimney-pieces, ornamental metal work of any kind, plaster figures, etc., is to give the subject a coat of japan, in which a small quantity of Brunswick green has been mixed, just sufficient to neutralize the brown color of the japan; and when almost dry apply bronze powder, either gold, silver, etc., with a large round brush to the prominent portions of the articles, but sparingly to the other portions; in fact, in the hollow and flat parts, only a mere suspicion. Care and some practice will be required to soften the highly-bronzed portions, so as to avoid abruptness, and also that the brush may not take up any of the japan or paint. If applied with a light hand and a very soft brush, the bronze powder will prevent this. Large earthenware jars, when first sized and then treated in this way, are most effective for decorative purposes. A thin, even coat of good varnish will insure the bronze keeping its color for a long time.

◆

"IT is not generally known, even among shoe dealers," said a shoe manufacturer yesterday, "that the hooks which serve in place of eyes for the laces of men's shoes were invented by a little old watchmaker in Aurora Springs, Mo. His name is Klinger, and he still lives there, working at his trade. He sold his patent for the hooks to a Boston man, who was out there looking for health, the price paid being $500. Last year the royalties on these hooks yielded the present owner of the patent the neat income of $300,-000."

◆

DID you ever have a pen full of ink drop out of the compasses on a finished drawing? What did you say?

FIRING DYNAMITE WITH POWDER CHARGES.

THE experiments with the Justin dynamite shell made at Perryville, N. Y., lately, were very successful. Some idea of their importance may be gathered from the fact that they have proved the possibility of throwing dynamite out of a cannon with gunpowder without bursting the cannon.

The cannon used was a piece cast in England during the Civil War, and did service on a Confederate ship. Dr. Justin's invention may be described, generally, as a cartridge consisting of a hollow steel cylinder. This contains, besides the bullet, a wooden cylinder, in which is the charge of dynamite, mixed in certain proportions known only to the inventor. The dynamite is prevented from exploding on the discharge of the gun by a graduated pressure air cushion which protects it from shock.

Inventors for years have experimented with "dynamite cannon," but their dynamite cartridges have invariably exploded before leaving the cannon. Gradew only used two or three pounds of dynamite, and burst numberless cannon and cartridges in his attempts. The Zalinski dynamite gun, and the dynamite guns on the '*Vesuvius*' are pneumatic affairs. The first test was firing a shell weighing 280 pounds containing 5¼ pounds of dynamite. The charge of powder was 12 pounds. The shell struck one side of the gorge, and about one-half of the dynamite exploded. The second shell was the same, using twenty pounds of powder. The third shell weighed 300 pounds, and contained 8¼ pounds of dynamite. The charge was 25 pounds of powder. This shot did great execution on striking the rock. At the cliff it burst, tore up the rocks generally, and split the steel bullet in half. The fourth and final shot was the largest fired in the gun since testing; 35 pounds of powder were used. The shell weighed 311 pounds and contained 19 pounds of the best dynamite. This shell blew to powder the quartz block which it hit, and the bullet ricochetted up cliff out of sight. The dynamite all exploded at the moment of contact. The shell exploded when it struck the rock, throwing heavy blocks of it about and scarring the cliffs with flying pieces of brass and steel from the shell. This was the grandest shot of the experiment. The large dynamite shell could be seen in its course through the air from the gun to the cliff of rocks, and looked something like an air ship sailing with immense speed.—*N. Y. Sun.*

◆

MILLER, Metcalf & Parkin, of Pittsburg, Pa., have fitted up in their steel works a dining room for the men, where a good dinner is served at a very low cost. This is a common plan in England, where such dining rooms exist in many of the large works, not only for the men, but oftener for the proprietors and the office staff, who eat their luncheon at noon in the works, and at the same time, have an hour of useful and instructive discussion. The Union Iron Works and the Pacific Rolling Mills Company in this city have adopted a similar plan for the staff, and the advantage will be obvious to anyone who has the good fortune of an invitation to luncheon at either of these works. —*Industries.*

◆

A MR. PARKHURST says in the *American Machinist*, "One use for emery wheels I have never seen mentioned is their capacity to grind rubber. I have ground soft, pure rubber rolls 6 feet long, 8″ diameter quickly and easily by using a coarse wheel, fed with chalk to prevent the rubber melting and adhering to the particles of emery.

◆

A PARAGRAPH instructing as to how to clean tile floors says: "It is important to keep anything greasy from them," closing with this: "When all the floor has been cleaned rub it over with a very little milk or salad oil, using a soft, old towel, and leave the milk or oil on."

Now, what shall we do?

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Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, APRIL 12, 1890. No. 8.

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WILL IT SELL?

THE main thing involved in every new machine, device, or process is whether it will sell or fall dead on the market. Many a capable machinist or inventor is busy at this moment elaborating something by which he hopes to realize a handsome sum, but he keeps on adding to it in such a way that it costs too much to make it, or, perhaps, emulous of a notice in the county paper, he tries to make it a "monument to his inventive genius." He wants some rural editor to say that he is "a rising young inventor," and so he makes a machine that has no commercial value.

Will it sell? This is the point, and a machine will not sell to any great extent if it is costly to make and keep in repair. It matters not all in the construction of a machine that it should look pretty to the public. If it does a great deal of good work it looks very pretty indeed to the buyer of it, and it is to him that the inventor looks for his market.

The greatest mistake an inventor can make is to devise inventions which have no future and no immediate practical value.

It often happens in the course of our business that subscribers write us saying that they have invented certain devices which they wish to put on the market, and desire to know the proper channels to follow successfully. If we could give these we could do a great service to many, but we do not think there are any channels other than those of regular trade. In order to find a market, an invention must really fill a want. Not in the inventor's view, but from the public. As we have said previously, the mechanical merit of it may be very small indeed, but any invention of value must do something of public utility. It must be of general use and application; if it is it will not lack buyers, who can only be found by searching for them. Publicity is necessary. The bare fact of a man having patented a useful invention is known only to himself, not to those who need it; therefore, it is necessary to advertise it in one way or another, and to constantly follow it up, the same as any other business venture. This demands both time and money, neither of which, as a rule, the average inventor has. In this event he must apply to the middle man, or let his invention out upon royalty to reliable concerns. Suppose a man invents a pump, for example, unlike any other. Let him obtain the names of manufacturers in that line who are well known, and write them; if his his invention is of value he will be sure to here from the manufacturers in due course, because such concerns are always on the look out for new goods that will sell. If he does not hear in a reasonable time let him write again, calling attention to his first letter, and if this does not bring a reply the inventor should try some one else, until he learns that there is or is not a demand for his invention. All letters to manufacturers should be as brief as possible; do not introduce anything outside of the invention. Do not refer to poverty of finances or anything but strict business. For instance, copy this letter and use it as a model for such communications:

MESSRS. BLANK & BLANK:
New York, N. Y.

GENTLEMEN—I have invented a new method of sewing buttons on trousers for which I hold letters patent No. 000,000, dated January, 1890. I am desirous of putting this machine in the market and, knowing that you use such machines, have written you first. Will you advise me on receipt of this letter whether you are open to negotiate for the machine in whole or part, rights to use, or total possession?

Respectfully yours,
John James Johns,
No. 000 Machine Street,
Newark, N. J.

Give your address plainly and wait a week or ten days for a reply. If none is received write this letter:

MESSRS. BLANK & BLANK:

GENTLEMEN—Your attention is respectfully called to my letter of March 20, concerning a machine for sewing buttons on trousers. Not hearing from you in due course, I ask you to give me a specific answer to it, as I wish to put my machine on the market at once.

If no answer is received to this either, in two days, do not waste any more time on men who do not know enough to answer a business letter, and, like Dogberry, thank God you are well rid of them, and let them go their ways; but keep trying and keep negotiating always and constantly, if you wish to sell your invention. Avoid as you would a bunco steerer all agencies which pretend to be able to sell your patent in open market. No one can do this, for there is no "open market" for patents, and nine out of ten of such concerns are gross frauds.

BREAKDOWNS.

IT is easy to sit in a chair in an office and say what should or could be done in a breakdown at sea, or in any place remote from a shop, but it is not so easy to find a remedy for an actual breakdown of a serious nature when brought face to face with it. Nevertheless, it is well to reflect that parts which have to be replaced do not always require to be actually as heavy as those which are broken, for these are intended to stand hard work for a long time, and details which are much lighter than they are will enable one to get within the reach of help, or keep head on to a sea. A pump is not hopelessly disabled because its piston-rod is broken; it is not even necessary that the make-shift rod should be round, for the matter of that. A handy man can make a serviceable rod out of a bar of square iron with the corners rounded off, so as to go through the stuffing-box gland; and as for packing it, a turn of lead pipe or a few leaden washers will soon fill the space, so that it will be practically steam and water tight. As for valve stems, unless they are of large size, on the main valves, it is a small job to make one.

Engines do not break where they are expected to. Generally, they fail in the parts which are supposed to be the safest, and it is hard to say just what details should be carried in duplicate; but in the minor disasters which are likely to overtake anyone, we should not give up the ship because we cannot refit details as we would if the shop was behind us.

IT SHOULD BE A PENAL OFFENSE.

IT seems to be incumbent on some one to introduce a bill in Congress which shall become a law that all common carriers of passengers and merchandise shall, upon the occurrence of accidents, immediately forward a full report of the same, including all details so far as known. This is not done now for the reason that it is supposed to injure stock companies—depress the shares—so that some one loses a little money. This is absolutely all that was vouchsafed the public on the occasion of the accident to the '*City of Paris:*'

"On Tuesday, March 25, at 3:30 P. M., when 216 miles west of Fastnet, the starboard engine broke down from an unknown cause. The cylinder went to pieces, injuring the bulkhead and breaking the injection and water pipe connections and allowing a considerable quantity of water to run into both engine rooms, adjacent sections. No one on board was injured."

It is quite plain that there are other interests connected with such disasters than the rise or fall of the company's stock, and not the least of these are the underwriters and insurance companies. Since the facts cannot hurt legitimate interests, and they are bound to come out sooner or later, it is due to the people that the fullest publicity be given to every disaster that happens on sea or shore. It should be made a penal offense to suppress such intelligence.

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IT is quite possible to cut water gauge glasses too long, so that the area at the ends is not equal. Suppose the area left is less than the tube-bore the glass will show false. This was the case on the Ss. '*Barracouta,*' which exploded one boiler. The engineer examined had this fact pointed out to him, but he said it made no difference! It makes a great difference,

THE "COMMITTEE OF PASSENGERS."

It was Sir Charles Grandison, we believe, who said that bores had a great charm for him, because one never knew what they were going to do next, and engineers can say the same concerning passengers on their vessels. It is not because they ask the most astonishing questions about the machinery, or because they imagine, for some reason unknown, that they stand upon a higher social plane than the engineer, and patronize him by giving him bad cigars occasionally, but principally for the reason that when emergencies arise one never knows what the average passenger will do. Emergency or no emergency, there is always some busybody aboard itching for notoriety, who can be relied upon to distinguish himself as an A 1, copper-bottomed ass. This is in evidence as to what happened to the chief engineer of the *'City of Paris,'* last summer:

> "Concerning the disaster to the steamer *'City of Paris,'* H. D. Pierce, of Indianapolis, who was a passenger when that ship made her famous passage inside of six days last August, says that the strain upon the engines and machinery was so great as to attract attention, and finally a number of passengers who had crossed before held a meeting and called in a body on the chief engineer, who declined, perhaps properly, to permit a committee to go below in his department for any purpose, and refused also to communicate anything regarding the revolutions of the screws. The record was lowered to 5 days 23 hours and some minutes."

This is too funny for anything. Imagine a "committee of the passengers" going below in a steamship to judge of the "strain" on the engine! It did not occur to these imbeciles that they were not capable of judging of anything, but they were perfectly willing to assume the functions of the chief engineer. What did they suppose he was there for?

Engineers are sometimes accused of being discourteous and curt in their manner towards passengers; they never are to sensible men who are not first discourteous to them, and the chief engineer of the *'City of Paris,'* Mr. Earnest Gearing, at the time named, we believe, had rare self-control when he did not utter some burning words to the spokesman of that "committee of passengers."

FOLLOW THE DRAWING.

It is a queer streak in human nature that some are incapable of comprehending plain written directions, but must have everything explained by word of mouth. Recently we wanted a cushion for a lounge. We made a sketch of it showing dimensions every way; we made a complete specification of it as to material, cover, etc., etc., and sent it to a large house with which we have dealt for years. Two days afterward a man came down with the sketch in his hand.

"We don't understand this sketch very well," he said.

"What is it you don't understand?"

"Why it says ten inches across here."

"Well, why not make it ten inches then?"

"And it says nine inches thick!"

"Why not make it nine inches thick?"

"It says thirty inches long!"

"Why not make it thirty inches long, unless you have some objection to the dimensions."

"These are very unusual sizes for a cushion."

"What have you to do with that? The cushion is for us, not for you."

"We thought there must be some mistake."

"Very well, let there be a mistake. So far as you are concerned you have nothing to do but obey orders, and let the man who makes the mistake pay for it; that is wholly his affair and not yours in any part. You say you do not understand the sketch; you understand it perfectly, for you explained it to us. You have lost two hours' time coming down here for nothing, solely because you do not understand business principles."

Follow the drawing if it leads to the scrap heap.

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A CABLE's length is 607.56 feet.

UNSINKABLE SHIPS.

Enough is known at this writing to show that the *'City of Paris'* escaped afloat from a grave disaster, and that she came into port with several compartments full of water. This proves incontestably to some that the system itself is an insurance against the perils of the sea, and that a ship so constructed is unsinkable. It seems that the final or actual test of the value of compartments is yet to be proven. That the *'City of Paris'* is now afloat is due to two things, principally her enormous size, which enabled her to carry a dead load of thousands of tons of water, and the good weather which prevailed during and after the accidents. The breakdown of the starboard engine might have reasonably been expected when the *'City of Paris'* was laboring in a seaway, as well as when she was on an even keel in comparatively smooth water. Suppose the same accident which has happened had taken place in bad weather, that the 2,400 tons of water which found its way into the compartments had rolled backwards and forwards thwartships a few times, where would the *'City of Paris'* be now? She would have turned turtle in a very short time. No longitudinal bulkhead that a ship could carry can withstand the impact of a quarter of 2,400 tons, and it is a most fortunate circumstance that the longitudinal bulkhead on the *'City of Paris'* was broken through, for it actually saved the ship by keeping her on an even keel. As to whether an unsinkable ship can be constructed that is a difficult question to solve. Absolute reliance cannot be placed upon bulkheads, for the unexpected always happens, and precedents are wanting to enable naval constructors to see exactly what to provide against. The *'City of Paris'* represents the most advanced thought and embodies the latest improvements in naval architecture; yet, had not the elements aided her, she would now be another mystery of the sea.

FOUR HUNDRED AND FIFTY DOLLARS.

This sum is what the vessel owners on the Great Lakes propose to give for the six months' labor of a chief engineer on their large steamers. These vessels are in all respects ocean steamers in size, duty required, and responsibility of the chief engineers, and we have no hesitation in saying that it is a wholly inadequate payment for the services rendered. It is not even good policy, leaving all other considerations out of the question, to pay such low rates to engineers, for it is impossible for them, no matter how conscientious they may be, to consider the owner's interest when they feel that they are looked upon as mere hirelings, to be obtained at the lowest sum possible. It seems hardly necessary to tell American vessel owners that the way to get good men on their ships is to pay them living wages, for when engineers, pilots, or whoever they may be, are torn with anxieties and efforts to make both ends meet at home, it is very certain that they can not and will not pay much attention to the owner's interest. We have said it is bad policy to starve employees, and it is plain that we are right in this, for the profits of a season depend very largely upon the economy with which the vessels are run. Engineers can burn little or much coal; they can use oil and stores generally *ad libitum*, or they can run the ship as if it was their own, if they feel that their efforts are recognized and their status as responsible members of the community acknowledged. What obligation is an ill-paid engineer under to render his best services? None whatever; he has been ranked on the start as part of the vessel's outfit, and if he is put upon that basis he is certain to act up to it. It should not require any argument to prove this and we hope to see the Vessel Owners' Association act squarely to its employees and pay them adequately for their arduous work. We observe that the Lake Carriers' Association, comprising the leading vessel owners of the Lakes, have this for their object:

"To consider and take action upon all general questions relating to the navigation and carrying business of the Great Lakes and the waters tributary thereto, with the intent to improve the character of the service rendered to the public, to protect the common interest of Lake carriers, and promote their general welfare."

We request them to note that the first step toward the realization of their ends is to pay living wages. All other steps come after this.

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Ericsson, says Prof. MacCord in the *American Machinist*, insisted upon having his plans followed to the letter; his drawings were complete to the smallest details, and he would tolerate no deviation; in which he was clearly right, since the whole responsibility rested upon him. He argued that if an inch were given in this direction an ell would be taken, and the result would be endless confusion and uncertainty. An amusing incident, illustrating his pertinacity on this point, occurred during the building of one of the larger monitors. His outside superintendent of this work came one day with a beaming countenance to report concerning the engine bulkheads. The rate of progress was quite satisfactory, but he could not refrain from stating that he had had the rivets headed up with a button-set, as he thought that made a better finish.

"Ah, indeed!" said the captain, "how many have you put in?"

The superintendent pointed out on the drawing how far he had gone.

"And they look *well*, do they?" continued Ericsson, to which, of course, he received an eager and emphatic response in the affirmative.

"Very well; now to-morrow you will be good enough to have them all cut out and replaced by others rivetted up with the hand-hammer, with a conical finish, according to the drawing."

And this unexpected instruction the crestfallen man was obliged to execute.

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A Mr. Hoffman, of Charleston, W. Va., has patented a band-saw wheel with a groove in the middle to produce equal tension on the two edges of the saw blades. This, we think, will do no good. There is a good deal of edge strain on band-saw blades, but it comes usually from bearing too hard against the guides. In operating a band-saw of any kind, the attendant should at intervals put a block behind the saw and bring it forward, clear of the guides, and see if there is undue pressure on the back. The top wheel should be so adjusted that the saw will barely run back against the guides, and exert no pressure there. There is, perhaps, no other cause that breaks so many saws as bending them edgewise. This applies to saws of all widths. A narrow one shows this, and a wide one does not, but both are strained the same on the teeth side, where cracks soon begin if there is much pressure against the back guides. Rollers or wheels behind saws present only a line of contact, and "upsets" the back of the saws, curving them edgewise.—*Industries.*

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It is not generally known that the *'City of Paris'* has never been formally accepted by the Inman Line. By the terms of the contract she was to make a certain number of trips under certain conditions. These would have been complied with had she arrived in Liverpool all right on the trip she broke down. What the result of this accident will be in connection with her acceptance is a matter between the prospective owners and the builders.—*Marine Journal.*

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People pretend that they have snakes and other reptiles in their stomachs! The gastric juice is so caustic that it will blister the hand if applied to it. Snakes have no show in it.

Foreign and Domestic Trade Literature.

COMPARISON OF ENGLISH AND AMERICAN METHODS.

THE American attitude towards science is radically different from ours. In this country we have too much respect for what is called "pure science." The measure of value of science is its immediate or probable future applicability to useful purposes. It must be distinctly understood that by pure science we do not mean what many people loosely term theoretical knowledge. Theoretical knowledge has a value that cannot be underrated. It is not merely useful, it is indispensable. If a man investigates the composition of Sirius his results are of no practical value. His work may be extremely engrossing, and the account of his researches may be very interesting reading, but it cannot well be regarded as work of practical value. An investigation of the tides, on the other hand, is a different matter; it is immediately useful. Now if a man spent a large portion of his time in studying the composition of Sirius, and evolved a number of speculative theories about it, he would be made a member of a number of learned societies and would become a distinguished authority at once. If another man of equal ability spent the same time in examining the properties of various insulating materials under various practical conditions, and found out enough to help electrical engineers out of all the difficulties that are dimly seen in the future, he would remain a nobody unless he chanced to procure a patent; and a section of the public would infinitely prefer to intrust the care of the lighting of a town to the astronomer than to the insulation inventor, because the former would be considered a distinguished scientific man. The Americans, perhaps, go a little too far the other way in their idea of what an electrical engineer ought to be, but they judge a man by his practical success.

There is still another important difference between American and English practice. In America they really understand the subdivision of labor. In England the same man has often to design machinery, manage shops, look after correspondence, superintend outside installations, canvass for orders, and work up the business generally. This evil partly arises, of course, from our system of comparatively small companies. In America there is a staff for each of these departments. Here we do not experiment in a systematic way. Every maker of any importance should have a special experimental department with a special experimental staff. At present most people would regard all that as reckless extravagance. We think quite the reverse, as the experiments must be done some time or other, and they are done, but they are done on machinery which is already on order, and this is the most expensive way of making experiments.

The last point is that there seems to be some difference in the matter of "push." If the electrical business was carried out more on American lines, is it not likely that such branches as mining work, electrical tramways and railways, and motor work generally, would be farther forward than they are? * * *

The most remarkable difference is in the system of supply. In this country a maker of dynamos, for instance, does not turn out hundreds of the same size and type; he makes them of all sizes, to go at all speeds, and give all sorts of outputs. This is not because the makers like this mode of manufacture, but because the customers demand it. The maker may, perhaps, charge an extra price, and thus make a little more on each machine, but the price is increased, and increased price means decreased total profits to the business, though the profits per machine may be greater. Why, it may be asked, is the customer not content with the stock sizes? The customer is a small contractor, in all probability, and suffers from a weakness which seems almost universal in the electrical industry. Every electrical engineer thinks he is an inventor. Even if he does not want the plant to be made so as to work in some invention of his own, he may have a lot of little fads which have to be considered. He probably likes the dynamo to run absurdly slow or ridiculously fast, or he likes it coupled direct to some favorite engine, which he thinks is superior to all other engines. If the installation is large, the engineer insists on pushing in some product of his own brain, and the whole thing is called his "system." This evil becomes greater the more important the station. In the whole of the United Kingdom there are, probably, no two installations alike. In America the contractors supply the machinery of the type found by them, after considerable experience, to be good, and that machinery is put up in exactly the same way as exactly similar machinery for exactly similar purposes has been put down before, and it works without a hitch just as it worked before. The people who put it down do not settle what machinery to use, or interfere with the design in any way; they merely carry out the designs of experienced engineers, who have, under a very perfect system of division of labor, perfected every detail. Of course, the difference is that in America the plant is supplied by large contractors, and the engineers who erect it are practically the contractors themselves. The American arrangement of business tends to the development of enormous companies, and these absorb all the engineers, and the man who in England would be a small contractor is a member of the staff of a large concern. It would be exceedingly difficult for an electrical firm to begin business on this principle in England now. We believe the Westinghouse Company are going to try, and we wish them every success, and hope they will not only help to develop the electrical industry here, but that they will also show us how to do business on the wholesale interchangeable principle.—*Industries.*

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BERMUDA HOUSES.

HOUSE building in Bermuda, W. I., is done in a peculiar way. The material is quarried as follows: The first thing is to clear away the soil on top only a few inches deep, and expose the rock. A hole is then drilled vertically to any depth desired, six, eight, ten feet, in which a saw is inserted, and a clean up-and-down cut is made, which is repeated on a square of two feet until a column twenty-four inches square is sawed out and laid on the ground. This is then sawed into blocks six inches square and two feet long; each block, when properly seasoned, is worth seven to fifteen cents each. This is another Bermudian peculiarity, the "seasoning" of stone. When the blocks are freshly cut, they are a creamy white in color, and so soft that they can easily be whittled with a knife. They are piled up in heaps like cordwood and left exposed to the weather, and in a few months the surface becomes hard, and the color changes to a rusty gray. They are not nearly as handsome when seasoned, but much more substantial, and such heaps can be seen all over the islands. When the stone is particularly hard it is worked for a long time, leaving smooth, straight walls, for there is never any blasting, all the pieces being cut out with saws. Deserted quarries are often turned into barns and other buildings by the addition of another wall or two and a stone roof, so that when you climb down a Bermuda hill you are never quite sure whether you are on the greensward or on somebody's roof.

The stone when first cut out is not only light in color but light in weight, and exceedingly porous. Dip one of the blocks in a pail of water, and it will absorb almost as much as a sponge, and it does not lose this undesirable quality after it is seasoned. When the mason takes it in hand he has a world of sawing and squaring to do. This block must be made to fit in here, and that there, and the sawing takes more time than any other part of the work.

The stones are set in the wall with a mixture of Portland cement and sand, and when the walls are finished they are covered inside and out with the same mixture, and thus made impervious. It is the only way to keep the house dry and preserve the stone. When not cemented outside the stones are soon washed into little grooves and furrows, and eventually crumble.

For his roof the Bermudian saws the stone into "slates" about two inches thick. These roofs look as if they were made to stand through all the ages, but they are not as strong as they look. I saw a man walking over one day and with every step it sunk under his feet, and there was an undulating motion like waves all over it. When the walls and roof are coated with cement they are ready to be whitewashed. The lime does not rub off and soil clothes as some whitewash does, because it is "set" There are a number of ways to make it stick with which most housekeepers are familiar. A little glue added to the wash will do it, but glue costs money. Molasses will also do it, but then it is necessary to make the mixture yourself, for if you hand the molasses to a darky he will go around a corner and drink it. So the Bermudians fall back upon the leaves of the prickly pear, which, when bruised and stirred in the whitewash, "set" it so effectually that you can rub a black coat against it without any coming off. Then, as far as the masons are concerned, the house is done. There is not usually any cellar, for a cellar is likely to turn into a well when there is a heavy rain.—*N. Y. Times.*

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COST OF ELECTRIC LIGHTS IN CITIES.

SOME time last fall a committee of the council of the city of Scranton, Pa., which had been appointed to investigate the matter of electric lighting and the differences which had arisen between the city and the local company, made its report. This committee, "in order to deal intelligently with the question in hand, had deemed it wise to correspond with other cities in the United States, and to gather such data as they might have to furnish for the guidance of their deliberations." The answers received as a result of this correspondence were tabulated for more convenient perusal, and now furnish not only the most complete but also the most reliable statistics upon the subject which have been compiled up to this time. The following table presents the figures for those cities in which arc lights were supplied by contract with private companies. All lamps are 2,000 candle power except in Newburg, Norwalk, Richmond, Va., Northampton, Mass., Taunton, and Concord, whose lights are 1,200 candle power. The area lighted is, in every case, the entire city. In Scranton alone the radius is a factor in the cost:

Name of Place.	*No. Lights.*	*Cost per Annum*	*Hours Lighted.*
Alliance, O	8	$144 00	All night.
Janesville, Wis.	8	100 00	Midnight.
Cedar Rapids, Ia.	10	126 00	Except moonlight.
Gloucester, Mass.	13	96 00	12 o'clock.
South Bend, Ind.	14	100 00	12 o'clock.
Union City, Ind.	22	95 00	Except moonlight.
Ashland, Penn.	23	125 00	All night.
Keokuk, Ia.	24	126 00	Except moonlight.
Ogden	25	133 36	12 o'clock.
Bath, Me.	27	100 00	5 all night, 22, 12 o'clock.
Keene, N. H.	27	100 00	12 o'clock.
Chattanooga, Tenn.	30	121 66	All night.
Wooster, O	30	108 00	All night.
Concord, N. H.	39	100 00	12 o'clock.
Waltham, Mass.	32	127 00	1 o'clock.
Jacksonville, Ill.	32	100 00	Except moonlight.
Charleston, S. C.	35	144 00	All night.
Fond du Lac	36	72 00	All night.
Lockport, N. Y.	37	80 00	Except moonlight.
Ashville, N. C.	37	106 00	2 A. M.
Burlington, Ia.	39	130 00	2 A. M.
Taunton, Mass.	44	110 40	Schedule moon.
Yonkers, N. Y.	45	60 00	All night.
Wilkesbarre	48	144 54	All night.
Cortland, N. Y.	50	50 00	12 o'clock.
Columbus, Ga.	50	108 00	Except moonlight.
Vicksburg	50	114 00	Except moonlight.
Selma, Ala.	50	120 00	Except moonlight.
Fall River	50	180 00	All night.
St. Paul	50	127 75	Midnight.
Defiance, O.	52	60 00	
Lima, O.	58	100 00	1 o'clock.
Pottsville, Pa.	58	105 00	All night.
Portsmouth, N. H.	60	100 00	All night.
Adrian, Mich.	63	100 00	All night.

Winona, Minn	61	125 00	All night.
Hornellsville, N. Y.	64	100 00	All night.
Springfield, O	64	130 00	All night.
Battle Creek, Mich	65	85 00	12 o'clock.
New Britain, Conn	66	100 00	12 o'clock.
Paterson	70	100 00	All night.
Eau Claire	70	110 00	All night.
Somerville, Mass	70	135 00	1 o'clock.
Burlington, Vt	70	116 00	12 o'clock.
Logansport, Ind	75	100 00	All night.
Mansfield, O	77	75 00	All night.
Saginaw	80	100 00	3 A. M.
Joliet	80	120 00	12 o'clock.
Norwalk	82	70 00	12 o'clock.
Wichita	83	33 33⅓	All night.
Northampton	88	75 00	12 o'clock.
Petersburg, Va	82	96 00	All night.
Newburgh	97	111 00	All night.
Binghamton	99	140 00	All night.
Indianapolis	100	80 00	All night.
Waterbury, Conn	100	142 35	All night.
Racine	100	70 00	All night.
Sedalia, Mo	100	87 00	Schedule moon.
Atlanta, Geo	100	120 00	All night.
Allentown	101	100 00	Except moonlight.
Watertown	102	68 00	1 o'clock.
Galesburg, Ill	104	105 00	All night.
Galesburg, Ill	104	69 00	12 o'clock.
Boston	105	180 00	All night.
Sandusky	115	100 00	All night.
Milwaukee	130	150 00	All night.
Chillicothe, Ohio	121	80 00	All night.
Richmond, Va	133	146 00	All night.
Lancaster	139	124 10	All night.
Zanesville, Ohio	140	70 00	Except moonlight.
Norfolk, Va	155	100 00	All night.
Reading	156	146 75	All night.
Akron	170	78 00	All dark nights.
Youngstown	180	72 50	All night.
Massillon	180	70 00	All night.
Jackson, Mich	180	88 89	All night.
Mobile	181	91 00	Schedule moon.
Dayton, Ohio	200	150 00	All night.
Bloomington, Ill	211	108 00	All night.
Poughkeepsie	212	123 00	All night.
Lafayette, Ind.	214	50 60	All night.
Terre Haute	232	70 00	3 A. M.
Harrisburg	270	90 00	All night.
Troy	271	158 00	All night.
Springfield, Mass	300	83 33	All night.
Scranton	322	90 00	All night.
Toledo	400	100 00	All night.
Minneapolis, Minn	480	150 00	Except moonlight.
Philadelphia	800	177 00	All night.
New Orleans	1,010	130 00	All night.
New York City	1,357	90 00	(Bid May 1).

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CHIMNEY CLIMBING.

Recently the chimney of the Clark Thread Works, Newark, N. J., was struck by lightning, and badly injured. A man named Phillips undertook to ascend and rig up an apparatus to restore the chimney. As described in the *Sun* he worked as follows:

The chimney is 335 feet high, and the bell-shaped top flares out five feet beyond the collar. Phillips began work with a thirty-five foot fire truck ladder, whose spikes were sunk in a heavy plank. A second ladder, twenty-five feet in length, was lashed to this, and both were firmly anchored to the chimney with hooked spikes seven-eights inch steel driven into the Portland cement between the bricks. There was a lot of light and new ladders at hand, and before night Phillips had five of them in place.

Each ladder lapped on the one above for five feet. At its base a cross cleat of wood was lashed, and between it and the face of the chimney a stout plank was placed on two spikes driven into the brick-work. These shelves keep the ladders a foot from the chimney, and make stages upon which Phillips can stand. He carried up a tackle block and rope, by which each successive ladder was hauled up by his helpers on the ground. Phillips thought that he could put all of the ladders firmly in place, and reach the top of the chimney in two days, but in this estimate he did not reckon on the hardness of the cement in which sixty feet of the bricks are laid, and the mortar in which the remainder of them are bedded. Both mortar and cement were harder than any he had ever encountered, and his labor in driving the spikes was prodigious. When he quit work the top round of the upper ladder was 200 feet above ground. He has climbed other chimneys in this manner, but never went above 200 feet. How he proposes to master the difficulty when he reaches the eighteen-inch collar and the five-foot outward slope at the bell he does not tell, and it is hard to understand how he will overcome the trouble which he will encounter when he reaches the slope of cast-iron forming the huge cap. His bargain is to go up and rig a rope and tackle by which the workmen can ascend and examine the shattered brick-work. His ladders are arranged on the side of the chimney which was untouched by lightning, and he is in no danger from falling bricks. On the other side, however, a large mass of bricks forming the skin of the chimney bulge out and hang in a threatening manner. When a strong wind blows, the loosened bricks dribble down like drops of water from a leaky eave trough. It is believed that the chimney is badly cracked through on the north side and work will not be resumed in the mill until the damaged side of the big shaft has been inspected. The chimney is certainly good enough to carry off smoke and heat, but it is doubted that it will be safe to submit it to the ground vibration caused by the engines and machinery in the four huge mills surrounding it.

Phillips is an athletic man of thirty years and is used to working upon heights. Aside from driving the heavy spikes and adjusting the ladders, the work of climbing is alone enough to worry out the strength of an ordinary man, but Phillips climbs up and down constantly, and several times a day comes all the way to the ground. The perilous point in his task is when he secures the lower end of a ladder and then climbs it to affix the spikes half way up its length. One spike is driven under a round half way up the ladder and just above it another one is driven at the side of the ladder, and both are firmly lashed with rope.

A very simple and easily rigged apparatus was shown in this paper some years ago for the purpose in question. It can easily be applied to the Clark chimney.

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HISTORY OF ALUMINUM.

Lavoisier, one of the world's great chemists, first suggested the existence of metals in the ordinary earths in the latter part of the last century. In 1807 Sir Humphry Davy tried in vain to extract by the use of electricity a metal from an earth which contained aluminum. He discovered calcium, the metal base of limestone and sodium, a light metal that will burn if thrown upon water, and is component of common salt. He also discovered potassium, the base of potash. In 1824 Oerstedt, a famous chemist of his time, thought he discovered the metal aluminum, but it is doubtful whether he did. In 1827 the German chemist Wohler first proved clearly the existence of aluminum, but he secured it only as a gray powder. He dropped his experiments till 1845, when again he secured the metal, a piece not larger than a pinhead. With this, however, he was enabled to describe the wonderful properties of the metal. In 1854 Deville, a great French chemist, began to work on aluminum, and the Emperor Napoleon III. furnished him money to conduct experiments. He was the first person to produce the metal in considerable quantities. When Deville began to work, a pound of aluminum was worth about $200 by his process; in 1857 he had reduced the price to $60. His process continued to be the only one in successful use till 1885, in spite of the fact that many of the world's greatest chemists had devoted an immense amount of study to the cheapening of known processes. During this period from 1857 to 1885 the industry flourished in France, and ornamental articles such as opera-glasses and mathematical instruments were made of aluminum, while jewelry, cooking utensils and various other articles were made from alloys.

In 1885, at the meeting at Ann Arbor, of the American Association for the Advancement of Science, the Cowles brothers first made public a description of their electric furnace, wherein they had succeeded in reducing aluminum and others rare metals and producing alloys by a method cheaper by far than had ever been done before. This process is carried on in a carbon-lined chamber, with air excluded to prevent the carbon from burning. The furnace is heated by powerful electric currents. The temperature attainable, unlike that in ordinary fiery furnaces, is practically unlimited, and every compound that goes into the furnace must suffer decomposition. The results possible with this furnace are almost without number.

The discovery of this novel process and the possible cheapening of the products, including aluminum alloys, immediately gave an impetus to the investigation of methods of separating aluminum by means of electricity. The Cowles brothers established a large plant at Lockport, N. Y., where they have since steadily employed some of the largest dynamos the world has ever seen. At Milton, England, another similar plant was established in 1886. Like works have since been established, embodying their ideas, at Neuenhausen, Switzerland, at the Falls of the Rhine, and at Boonton, N. J.; likewise in France works have been established by Societi Electro Metallurgique, who, they claim, are infringers of their patents. At Bridgeport, Conn., there have come into existence within eighteen months a large rolling mill and factory for working up aluminum alloys. Since the starting of the Cowles enterprise in England, two large competing companies have been established there. The aluminum company located near Birmingham was started by H. Y. Castner, a Columbia College student, and had Sir Henry Roscoe, the most eminent chemist in England, as consulting chemist. This company had a capital of about $2,000,000 in cash. Another competing company, under the name of the Alliance, was started at Wallsend, near New-Castle-on-Tyne, to develop Dr. Netto's process, with a capital of $1,250,000, and Lord Charles Beresford as president. These two companies each made advances in cheapening Deville's old process, but only brought the price down to about $5 per pound, as against $1.50 per pound for aluminum in alloys made by the Cowles process. Both companies have gone into liquidation within six months, due largely to their rashness in establishing a capacity for production far beyond the developed demand for aluminum at the prices at which they could afford to sell it.

Within the last year and a half, C. F. Hall, an Oberlin student, who, through the development of the Cowles process, became interested in the subject of aluminum, started the Pittsburg Reduction Company. As the Cowles boys had made their first experiments with a piece of a chimney flue and a borrowed current of electricity from the Brush lighting station in Cleveland, so Hall secured his first aluminum in an oyster can. The Hall and the Cowles processes may be said to be modifications of one process. Aluminum affords such a fascinating field of labor that men are heard of everywhere who have alleged processes of extracting it cheaply. Their number is legion and has been ever since Deville's time.

Practical men doubtless will inquire whether the aluminum industry has been really a paying investment to anybody. To this question even the most enthusiastic believer in aluminum and its future must reply that the industry so far has not been very profitable to any of the numerous persons and companies engaged in it. The reason given by the aluminum men is not that there is any doubt of the usefulness of the metal at the prices at which it can now be produced, but that manufacturers do not yet understand its properties. They say that just as Bessemer had to wait for years before the merit of his process for making steel was acknowledged, so will the aluminum companies which have laid the foundation of success be compelled to wait till the merits of the beautiful white metal are more fully recognized before fortunes can be made by separating it from the substances with which it is too tenaciously combined.

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Persons in the United States having correspondents in Colon will do well to remember that by order of the Director General of Posts and Telegraphs of the republic all correspondence which may be received at the Post Office here addressed "Aspinwall" will be returned to the office from which it came as being misdirected. The geographical and official name of this town is Colon.

THE LIMIT OF VISION.

It is often a matter of interest and importance to know how far one can see from any given height, or, conversely, how far one must be above the earth to see an object at a given distance. The exact calculation of these figures would require the use of very complex formula, but for practical use two simple rules will suffice: The distance in miles at which an object upon the surface of the earth is visible is equal to the square root of one and one-half times the height of the observer in feet above the surface; and, conversely, the height in feet to which an observer must be placed to see a distant object is equal to two-thirds the square of the distance in miles.

For instance, the observer is in the rigging of a ship 100 feet above the water, how far distant is the horizon? That is, how far could an object floating in the water be visible before being hidden by the convexity of the earth? One and a half times 100 is 150, and the square root of 150 is, approximately, 12½; therefore, the horizon is 12½ miles distant. As the deck of smaller vessels, like pleasure yachts, is rarely more than 10 feet above the water, it follows that the limit of vision from that point is less than four miles in every direction. An illustration of the second rule may be given as follows: A building is 33 miles away. How high a hill must one climb in order to be able to see it? As the square of the distance equals 1,089, and two-thirds of that number equal 726, it follows that we must climb a hill 726 feet high before we are able to see the building, even with the most powerful telescope.

Usually, however, the height of the object, as well as that of the observer, must be taken into consideration, but this simply requires the duplication of the problem. For instance, the Washington Monument is 552 feet high. At what height must an observer 50 miles away be in order to see the top of it? Supposing the observer to stand upon the ground, we find by the first rule that he could just see the top 29 miles away, and to overcome the remaining 21 miles, due to the convexity of the earth, he would, by rule second, have to climb to the height of 294 feet. If we apply similar calculations to the Eiffel tower, the highest artificial structure in the world, we obtain some interesting results Assuming the height to be just 1,000 feet, we find that, standing at the top, we enjoy a circle of vision bounded by a horizon 39 miles distant, and that, if another similar tower should ever be erected, it could be placed over 78 miles away before the rays of the electric lights on their summits would be eclipsed by the intervening earth. From the summit of Mount Evrest in the Himalayas (27,000 feet) one could see nearly 200 miles, provided the air was clear enough, which would rarely be the case.—*Popular Science News.*

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The recipe for keeping young in spite of years is regular employment, participation in the activities of society and affairs, and rational pleasures. Those who engage in these with a keen relish will not grow old in the sense of losing interest in the world and its affairs. Years will accumulate and the end of human existence will come, but old and worn out in mind and spirit they never will be. It is often the case that men who have been prosperous for years retire from participation in active pursuits because they think it is due to old age, but it usually happens that such retirement is followed by invalidism and death. Having parted with what has kept them alive and vigorous, they die because they have given them up.—*Unknown Sage.*

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Captain Daniel B. Boden, formerly a well-known steamboat commander on the Hudson River, but of late living in retirement in Cooperstown, died on Friday at the age of 70 years. He was a past master in masonry, and was buried with masonic honors.

TRAINING FOR TRADES.

Professor Henry Dyer, of England, has a level head, and though an Englishman, he thinks just as a good many do in this country. The appended remarks from *Industries* are pertinent, and apply here as well as in England:

"The progress of technical education has been very much impeded by the extravagant demands of enthusiasts, and by vague ideas about the necessity of educating British workingmen. In my opinion there is far more necessity for educating British manufacturers, not only as regards improved scientific knowledge, but also in their social duties, and especially those they owe to their workmen. If they clearly recognised the worth of education and encouraged it, workingmen would soon take to it, and if they took a friendly interest in the welfare of their workmen we would hear little of strikes lock-outs and other labor difficulties. As a matter of fact the extension of labor-saving appliances in those industries in which goods are manufactured on a large scale has, in very many cases, reduced the workmen to parts of the machines, or to laborers who do unskilled work. For these men, what is wanted, is not so much technical education, which they have no opportunities of applying, but general education which will enable them to escape from the drudgery of their daily lives. This is true to a very considerable extent even with skilled workmen, and therefore the examinations which I have suggested should be comparatively easy, and their technical knowledge should be simply intended to enable them to go about their work in an intelligent manner. Their general knowledge should, however, fit them to act the part of good citizens—a matter of greater importance than mere skill in a trade. Opportunities should, however, be afforded to the most intelligent and persevering for passing to the higher grades, but no artificial system should be pursued which took good workmen from the workshop and unfitted them for any other useful work.

Our elementary education has produced a large number of men who would not condescend to a good day's hard work, and has overstocked the market with clerks: and, if we do not take care, technical education, so called, will do the same for the more genteel parts of the trades. The majority of those who at present attend science and technical classes do so, not that they may become better workmen, but that they may be relieved from working with their hands almost altogether, and I very much doubt if those who pass the greatest number of science and art examinations are the most expert in the workshop or the most useful in the management of business. The really successful technical education of the future will not be a mere smattering of science combined with a certain amount of practice, but will consist of the highest possible knowledge in special departments, which will enable its possessors to revolutionize old industries or to introduce new ones; and, however much manufacturers may wish to have workmen with a fair amount of scientific training, it is of much more importance to them, at least from their ordinary point of view, to have a few highly skilled engineers, or chemists, or artistic designers, as the case may be.

I make these remarks for the purpose of indicating that, in my opinion, the future happiness and welfare of the great majority of the working classes will depend much more on a good general, than on a narrow technical education; because then, not only will they be able to rise above the mechanical drudgery of their daily work, but what is of more importance, they will, as educated free men, have the determination to withstand the attempts of unscrupulous capitalists to use them as machines for grinding out dividends apart from the consequences either to themselves or to society. It is, therefore, highly necessary that tradesmen and craftsmen should make themselves acquainted with the history of economic ideas, and of industrial and commercial institutions, so that, in making arrangements for the future, they may be guided by the experience of the past and be able to rise above the merely selfish class feeling which is too apt to be engendered when only present wants and conditions are considered. They would, among other things, do what they could to assist in the terrible problem of unskilled labor, with its long hours of monotonous, soul-destroying work, or its body-destroying slavery; for if this be not done, the whole movement for the improvement of the position of tradesmen and craftsmen, would lead to the establishment of a select body in comparative comfort, and a great mass in the deepest degradation. All real social reform must permeate the whole community, and not create a caste system which, in many cases, would be more heartless than the present.

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There is reason to believe that the addition of sugar to mortar is an extremely valuable discovery; it enables bricklaying to be carried on in frosty weather. About two pounds of coarse brown sugar to a bushel of lime and two bushels of good sand is the proportion for a mortar that will resist frost admirably. It is claimed that in addition to this advantage mortar with sugar mixed in it is vastly superior to mortar without it. It sets as hard a cement very soon, makes the brickwork extremely strong, and is quite effective when used with dry bricks. For indoor plastering, also saccharated mortar sets hard quickly. Where portions of the same wall have been covered in one part with sugared and in another with unsugared mortar, the latter has ripped up directly when a nail was run over it, months after the former had become as hard as stone. A Mr. Crampton, of Cranleigh, Eng., reports some interesting experiments. He points out that if sugar be added to mortar that is already made, it will render it too thin. Strong-sugared water dissolves lime in the same way that water dissolves sugar. It is therefore necessary to dissolve the sugar in water first, and then add the sugared water to the lime slowly and cautiously. The mortar should be as stiff as it can be used. For whitewashing, one pound of sugar to sixteen gallons of water will make it adhere firmly. Drops of whitewash made with water so mixed, if they fall on the floor or window, or an iron plate, cannot be washed off. They stick like enamel, and have to be scraped off.—*Manufacturer and Builder.*

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Very frequently stokeholds are made much hotter than they should be by the injudicious arrangement of ventilators, and insufficient openings for the escape of the hot air above the boilers. It is common to find the ventilating pipes from the atmosphere reaching only to within 10 ft. or 11 ft. of the fire-room floor, in order to permit of the opening of the smoke-box doors. When combined with this there is a deficiency of outlet for the hot air over the boilers, such stokeholds will be very close and hot, when from atmospheric conditions the downward current through the ventilators is weak. Such cases would be greatly relieved by extending the ventilating pipes downwards to, say, 6 ft. of the fire room floor, and enlarging the openings for escape of hot air above the boilers. The ventilators can easily be made to accommodate the opening of the smoke-box doors, which is seldom required.

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Artificial ice making has become a commercial business, and is every day being more extended. It is some twenty-five years since it was first manufactured on any large scale; but there are now, in the aggregate, some 100,000 tons made every day in various parts of the world, besides refrigerating and cooling plants equivalent to five times that amount, and the demand is increasing by bounds—in fact, the supply cannot meet the demand.

USE AND ABUSE OF FORCED DRAUGHT.

By foreign advices it appears that one evil which engineers on this side of the Atlantic have apprehended as regards forced draught has already been experienced abroad, and English naval officers are condemning it.

Admiral Mayne says it is "an invention of the evil one." Admiral Sir George Willes says that he thinks "the power of using a forced draught a very dangerous one to place in the hands of any captain." Admiral Morant said at the Institute of Naval Architects that he had made trials of it on two occasions with the result that his ship could hardly crawl back into port, the boilers had been so badly affected.

On the other hand, Admiral de Horsey says that a moderate forcing of the draught when some emergency arose was a most valuable addition to a ship. He therefore suggested a safety valve for the stokehole. In explanation of this suggestion it may be said that when the draught is to be forced the compartments where the boilers are situated are sealed air tight, and fans force air into those compartments. As there is no escape for the air save through the furnaces, the draught is increased and the generation of heat and steam are increased. The pressure of air in the stokehole is commonly measured by a column of water in a glass tube, something on the principle of a steam gauge. A moderate pressure gives a column half an inch high. In torpedo boats it is usual to run with a pressure of 2½ or 3 inches of water, but in testing both torpedo boats and cruisers over the measured mile pressures of 4½ and even 5 inches are not unknown.

The trouble is in the furnace; the heat becomes so great that grate bars melt, while the boiler tubes expand unequally and become ruined. A boiler can probably be built to work constantly under any pressure that men can work under, but when it comes to firing a boiler one hour under no pressure, and then under three, or perhaps four inches the next, and then under none again, the joints cannot be made to resist the varying strains.

But a pressure of perhaps one inch could be resorted to in an emergency with perfect safety—the boilers would not leak beyond hope of repair at the end of the run. So Admiral de Horsey proposes to allow ship captains to use such a pressure at their discretion, but proposes to avoid the temptation to increase the pressure by putting safety valves on the stokeholes so that the air can escape as soon as the prescribed pressure is exceeded.

It seems from this that the captain is the person who is in charge of the forced draught on English ships? However this may be, there is no question but that the statements made as to the abuse of forced draught are correct; this is simply abuse, and needs no comment. As to putting a safety valve on the stokehold a better safeguard would be to use smaller fans. They are all much too large. Fans are used for forced draught which are big enough for a twenty ton cupola in a foundry. In these places the air pressure seldom exceeds 1½ to 2 inches of water, and that is sufficient to run down cast-iron in a short time. The temperature resulting from 3″ to 5″ of water can be approximately imagined; it is needless to say that it is injurious to a modern steam boiler with thick furnaces and fire sheets. It is not the system of forced draught which is injurious, for it has been used in this country for half a century, but it needs restrictions as to its use.

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"It is said that the cost of building a fleet of Atlantic liners is a trifle compared to the cost of running them. In less than three years it will exceed the cost of construction, so enormous is the expenditure in wages, port duties and repairs."

How about the receipts? They must be enormous too, or else the ships could not be run.

CARE OF BELTS.

All leather belts, especially those used in flour mills and wood-working establishments, are subjected to dust, and no matter however soft and pliable a belt may be, it is only a question of time when this fine dust will effectually suck out all the oil, and render it hard and dry, and if the flesh side is run next to the pulley, and the pulley of small diameter, fine cracks will appear on the opposite side, crosswise, of a depth corresponding to the state and condition of the belt. These cracks frequently penetrate deep enough to materially impair its strength, and this is one strong reason, if nothing more, why the grain side of a belt should run next to the pulley. It will also be observed that this fine dust not only absorbs the original oil in the leather, but a certain amount attaches itself to the belt so as to cover the surface; by applying cold tallow the friction will melt it; this not only has a tendency to increase the coating of dust, but the tallow penetrates the belt, carrying with it dirt, acid, and all, which cannot, under any circumstances, improve its condition; like oil and rosin, it may afford temporary relief, but the remedy only aggravates the disease. Now the beneficial qualities of tallow for softening and preserving leather consist in the olein, while the margarine is destructive, and the stearine alone has a tendency to render it harder; therefore, when tallow is used for this purpose it should be so used as to exclude, as far as possible, these two latter elements. This can only be done by wetting the belts before the tallow is applied, which should always be in a melted state. But before it is applied the belt should be thoroughly cleansed from all dirt and gum, by thoroughly washing and scraping, if that is found to be necessary. The best and most practical manner of performing this operation is to take the belt off and stretch it upon a clean floor, then before it is wet fasten the ends to the floor with screws, which may be inserted through the holes for the lacing. This will prevent it from shrinking when the water is applied. Some object to wetting their belts for the reason that they shrink up so that it is a difficult matter to replace them again upon the machine, but by fastening the ends in the manner just described this objection is overcome. When the belt is thoroughly cleansed, and while yet wet, a thick coat of melted tallow should be applied with a brush and left in that condition until dry. In ordinary cases, if the tallow is applied at night the belt will be sufficiently dry to use the next morning. When tallow is thus applied, the stearine will not penetrate the leather when it is wet, and the margarine, having a greater affinity for the stearine and no affinity for water, will unite with the stearine and also remain upon the outside, while the olein, having so great an affinity for leather, that it will penetrate it, although it be wet; as the two former ingredients will become cold and hard long before the leather becomes dry enough to absorb them, the olein will all be taken up, while the other ingredients will remain on the outside in the form of a dry, white substance, which is of no further use and may be readily scraped off. If a sufficient quantity of tallow has been used, the belt will be as soft and pliable as new.

This process may be objected to by some because it necessarily involves a certain amount of time and labor; but, if belt users think it cheaper and less trouble to purchase new belts every few months than to take proper care of those they have, thereby prolonging their usefulness for years, that is a matter of their own choice.—*C. R. Tompkins.*

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A French paper says of a recent murder: "The miscreant was evidently in search of money, but M. Durand had prudently deposited all his cash in the bank, and consequently lost only his life."

On the trial of the '*Cushing*' torpedo boat at Newport, the speed attained was below 22.5 knots. The revolutions averaged 371 per minute, and the average steam pressure in the boilers was about 245 pounds. This pressure is said to have been maintained with comparative ease in the Thornycroft boilers, with only two men in each fireroom. The air pressure in the closed firerooms seems to have been very high, running up to four inches of water at times.

Officers who were on board the boat deny reports about the machinery breaking down. They say the only accident that occurred was the breaking of one of the mechanical counters for taking the number of revolutions of the engines.

The reasons given for the contractors for not making greater speed is that it was not to their interest to do so, and, contrary to the general supposition, that is true. Their original contract provided for a premium of $1,500 for each quarter of a knot between twenty-three and twenty-four, and $2,000 for each quarter of a knot above twenty-four. When, however, the Herreshoffs concluded that better results could be attained with the Thornycroft boilers, and obtained permission to substitute them for Herreshoff boilers, the Government, in consideration of getting a better boat, agreed to bear all the cost of making the change. This amounted to about $18,500, and, in consideration of the Government paying this bill, it was to offset any premiums that might be earned up to that amount. This being the case, it was obviously impossible for the boat to earn much premium, and the contractors, rather than push her and run the risk of serious breakdowns, simply aimed to run her slightly above the speed fixed by the Navy Department for her acceptance.

An officer who was on board said that he could run a week at 22 knots. It is claimed that she made over 24.5 knots on a private trial.

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The plan of profit sharing, which has been adopted in many large concerns, is the only correct principle, and when honestly carried out in good faith seems to be the correct principle of distribution. In those concerns the proprietors set apart a certain amount for the interest upon the investment and incidental expenses. Then their own salaries, added to the wages paid to their men, are deducted from the year's profits, and the balance shared with their men in addition to their regular wages. This plan has worked well wherever it has been adopted, and such concerns are more prosperous than those which are in conflict with their men on the subject of wages the greater part of the time. In the first place, the men have an inducement to work for the interest of the concern in order to increase the profits thereof, as by so doing they also increase their own compensation at the end of the year. It would seem that if a general system of profit sharing were generally adopted among the various manufacturers throughout the country it would go a long way in solving the present labor question that is now being agitated in this country.—*Age of Steel.*

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The town of Westfield, N. Y., concluded to put in water works, and a resident of the town, a banker, was placed at the head of the commission which was charged with carrying on the work. Instead of employing an engineer, this banker convinced his colleagues that he was fully competent to do the work. He undertook it, and they decided upon a gravity system. The banker—civil-and-hydraulic engineer—got some instruments and went to work. The blunders he made were, of course, numerous and ludicrous, the end of the matter being that the firm of contractors who undertook the work were involved in serious difficulty, and the town seems likely to have a lot of bonds outstanding with little or nothing of value in return for them.—*American Machinist.*

Yes, yes; they will do it.

TRADE NOTES.

Charles A. Hawkins, a well-known marine engineer of this city, was recently found drowned at Bridgeport, Conn.

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Third Lieut. Quinan and Assistant Engineer Myers have been detached from the revenue steamer *'Boutwell,'* at Savannah, and ordered to the revenue steamer *'Bear,'* at San Francisco.

⁂

Capt. D. F. Tozier has been detached from the revenue steamer *'Manhattan,'* on anchorage duty in New York Harbor, and ordered to the revenue steamer *'Forward,'* fitting out at Baltimore for duty in the Gulf of Mexico.

⁂

A board of engineer officers will be convened at the Treasury Department, April 14, for the examination of Assistant Engineers in the Revenue Marine Service for promotion, and a board of line officers will be convened at the same place, April 28, for the examination of Second and Third Lieutenants for promotion.

⁂

The last annual statement of the Newark horse railroad companies, recently purchased by Philadelphia capitalists, has been filed. The total cost of all the street railroads represented is $3,419,438.26. The roads have been sold for about seven million dollars, or more than double their cost to the owners.

Eh!

⁂

A change has been made in the management of the Detroit Dry Dock Company. John Owen, who has for many years been president, is now eighty-two years of age, and has sought retirement. His place on the board of directors has been taken by his son, E. J. Owen, and Senator J. McMillan has been elected president of the company. The value of the company's output for the past three years has been $2,500,000. The concern now employs 1,500 men, and has room for ten boats on the stocks at one time.

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The *'Newark,'* U. S. N. cruiser, launched on the 19th ult., is an American ship in design and intention, not built from foreign plans in any detail. She is a twin-screw ship 328' long, 49' beam by 31' deep, with about 19' draught. She has triple expansion engines of 6,000 h.p. natural draught and 8,500 h.p. at forced draught, and is expected to make 18 knots at highest speed. The engines are $\frac{34'' \times 48'' \times 76''}{40}$, driven by four boilers 13½' diameter by 19½' long, carrying 160 pounds per square inch.

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Charles H. Davids, engineer and machinist, 106 Liberty Street, New York, has issued a circular in which he says, "I have found that my facilities, though pushed to the utmost, have been inadequate to meet the demands made upon them. The result has been that I have had to decline many orders which I might have filled with satisfaction to my patrons and profit to myself. I have transferred my entire business to a corporation, known as 'The Davids Machine Works.' As general manager of this company I will have a corps of workmen and a complete plant of modern tools, which, for commercial purposes, will be unexcelled by any in the world.

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The launch of the side-wheel steamer *'Plymouth,'* built at Roach's shipyards for the Old Colony Steamboat Co., took place on the 6th instant. The *'Plymouth'* is 366 feet over all, 350 feet moulded length, 50 feet beam, 85 feet over guard, and 19 feet depth of hold. She is constructed on the double hull bracket plate and longitudinal system, giving her seven water-tight bulkheads and fifty water-tight compartments. thus securing as nearly as possible absolute safety. The vessel will have triple-expansion engines, with four cylinders of 5,000 horse-power. The cabinet work is exquisitely fine, all the saloons and staterooms being finished in expensive hard woods.

⁂

The Naval Appropriation Bill carries a total appropriation of $22,151,253, and provides for the construction of four new vessels of a class far beyond anything our naval architects have yet undertaken in size, efficiency and cost. Three of the vessels are to be battle ships of abont eighty-five hundred tons, designed to carry the heaviest armor and the most powerful ordnance. They are to cost, exclusive of armament, not to exceed $4,000,000 each. The fourth vessel is to be an armored cruiser of about 7,300 tons displacement, not to exceed in cost $2,750,000, which is to have a minimum speed of twenty knots an hour. A proviso requires one of the four to be built upon the Pacific Coast and one upon the Gulf of Mexico or the waters tributary, if they can be built at a fair cost.

⁂

The enterprising firm of W. B. Brook & Co., 47 Murray Street, New York City, will move May 1 to 40 John Street, where they will be better able to handle their rapidly increasing business. Messrs. Brook & Co. manufacture all kinds of mechanical rubber goods, belting, packing, hose, springs, valves, tubing, mats, matting, etc.; are sole agents for the celebrated Phœnix Gum and hemp core piston packings; the Perfection Oil Purifier (the action of which is based on the difference between the specific gravity of oil and water) and the Brooklyn Leather Belting Co's. pure oak tanned short lap, leather belting. Among the recent orders for the Brooklyn Leather Belting Co's., dynamo belting taken by this firm is one from the Germantown Electric Light Co., Germantown, Pa., for 200 feet 36 inch and 500 feet 10 inch, all donble thick.

⁂

Commercial camphor is now manufactured altogether in this country. The native wood fibers containing the gum are shipped here and distilled. The shipment to this country of the fiber is attended with a great deal of cost. The freight is $20 per ton, and in each ton the fiber and water amounts to 75 per cent. Of the 25 per cent. of camphor in the wood at the time of shipment, half of it evaporates during its transportation, leaving not over 12½ per cent. of the drug. To avoid the expense of the shipping of so large a bulk and to prevent the waste by evaporation, it is proposed to transfer the manufacture of the article to places in Japan near where the camphor wood is obtained. About one-fourth of the camphor used comes from Japan, and, should the plant prove a success, similar ones will be built there and erected by capitalists of this country, as a large saving will be thus effected.

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The Cataract Construction Company, which proposes to build a tunnel around Niagara Falls with a fall of one foot in a hundred, and to run machinery in factories by means of the water power thus obtained, signed contracts, April 1, with the Niagara Falls Power Company. The Cataract Construction Company is an organization formed under the laws of New Jersey. Its officers are New York men. Edward A. Weeds is President, F. L. Stetson, Vice-President, and W. B. Rankine, of Hawkesworth & Rankine, 115 Broadway, Secretary. The work of constructing the tunnel will be begun, it is said, as soon as the machinery can be procured. The land for miles about the village has been purchased by speculators, who expect to profit by the boom which they are sure is coming. The company is privileged by act of Legislature to furnish electricity for light, heat, and power throughout Niagara and Erie Counties, and has also obtained other valuable rights. It has purchased the stock of the local water company, and will establish a new plant.

⁂

The Detroit branch of the Brotherhood of Lake Engineers, amalgamated with the M. E. B. Association No. 3, Detroit, March 19, at a meeting held at the M. E. B. Association hall. The meeting was very large and enthusiastic, and all became brothers in the good cause. M. E. B. A. No. 3, Detroit, will keep their library room and hall, No. 17 Woodward Avenue, open day and night, where a register will be found of all engineers out of employment. Owners, captains or others wishing to employ such, can by telegraph or otherwise always find a man to answer any message promptly. All engineers are required to register. The Chicago branch of the Brotherhood of Lake Marine Engineers also amalgamated with the Marine Engineers' Beneficial Association, Chicago, No. 4, at a meeting held at the M. E. B. Association's hall. The meeting was very largely attended. Engineers can at all times be found at Coughlin's, 49 North Market Street, or Gallavans & Banner's, No. 30 East Kinzie Street, Chicago.

⁂

The Pennsylvania Railroad Company has established a training school in Philadelphia, at which institution brakemen will be put through a course to equip them for passenger conductors. Brakemen are selected from the various divisions and sent to Philadelphia to attend a series of lectures. The lecturer is a well-informed man, and to his class he displays a large map which shows all the lines of the road. He tells the relations of each line to the other, and goes into detail when describing the various divisions. Every geographical point is made clear to the class. Then comes the management of trains and the treatment of passengers. Questions regarding the payment of fares are fully explained. Each class is composed of not more than twenty men, and each pupil is expected to take notes as the lecturer proceeds with his explanation. Later on the men must pass an examination on the various points discussed. The idea of these lectures and examinations is to have competent men in cases of emergency, so that there will be no delay in filling a conductor's place if a train is divided into two sections, or, when necessary, to transfer a man on any division of the road.

⁂

An International Exhibition will be held in the Island of Jamaica, B. W. I., in January, 1891, under the auspices of the Government of Jamaica. In view of the increasing trade between the United States and the West Indies, the Committee have appropriated a large space for American exhibits; this is an opportunity which those interested in introducing American manufactures and extending the Export Trade of the United States should take advantage of No charge will be made for space in the Exhibition Buildings, nor will duties be levied on any of the exhibits, unless sold in the Island. The geographical position of the Island and the salubrity of the climate will undoubtedly attract a large number of visitors from the neighboring Islands and South and Central America, as well as from the United States. There is constant and regular communication by steam between New York and Jamaica, and the Island is also connected with the United States by cable. In addition to the present accommodations for visitors, a large hotel has been recently erected and opened, near the Exhibition Grounds, under American management. The regulations of the Committee, and full information as to the mode of shipment, rates of freight and marking of exhibits, and all other particulars as to the scope and object of the Exhibition, will be cheerfully furnished by Thomas Amor, Secretary to the Committee, Stewart Building, 280 Broadway, New York.

⁂

In conversation with Captain Alex McMaster, supervising inspector of the Ninth District, stationed at Buffalo, the subject of granting licenses to aliens was touched upon. The supervising inspector was positive in his views regarding the injustice that would be done to citizens of the United States, providing that foreigners could or had procured licenses; and said that while it was impossible to trace a man's career from the cradle up to the time of his application for a license—still every effort was made to ensure the granting of a license to only those who seemed to have proof positive of their right to be admitted as candidates for the honors. Should any case be brought before his notice where a person had procured a license through fraud or misrepresentation, or by concealing facts which ought to have been made known at the time of issuing the license, then gross perjury would be the least offense that they would have to answer for. The supervising inspector, however, who is a broad and liberal-minded man, detailed to the writer a little of his experience in the above line of duty. He said that some time ago he was furnished with a list of names of men who were accused of being ineligible to hold licenses on account of their foreign birth, etc. When these men brought their licenses along for renewal they were informed of the charges pending against them, and were sternly reminded that they must produce such proofs as would completely exonerate them from the charges made. The result was that several natives of the United States had to unearth their grandmothers' records, while naturalized citizens produced papers ranging from ten to thirty years old, which fully proclaimed their eligibility to hold and renew their certificates.—*Marine Record.*

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In former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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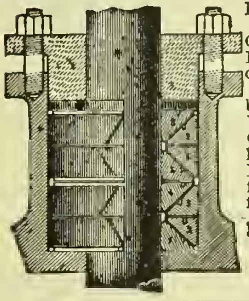

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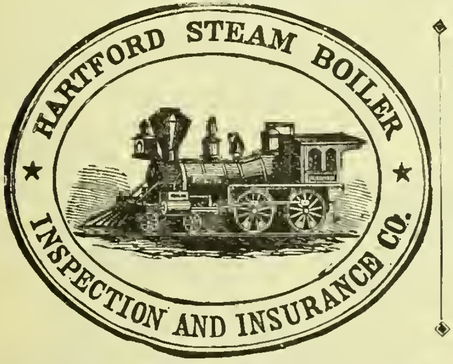
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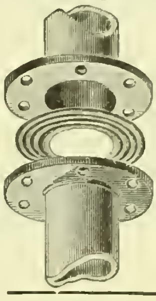

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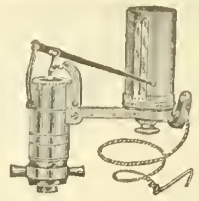

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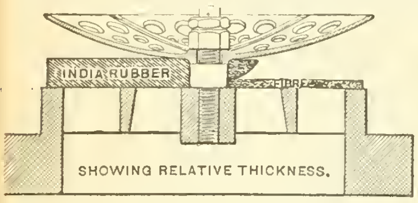

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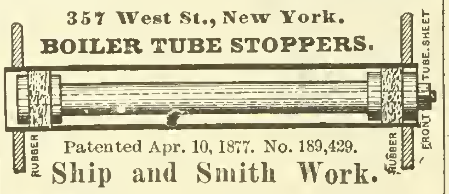

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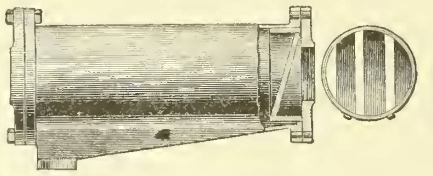

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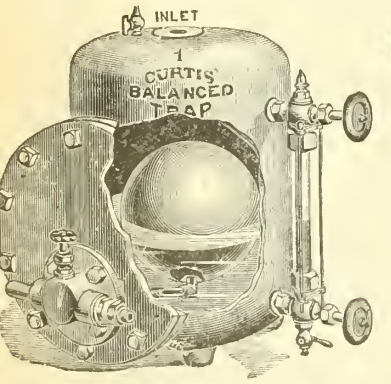

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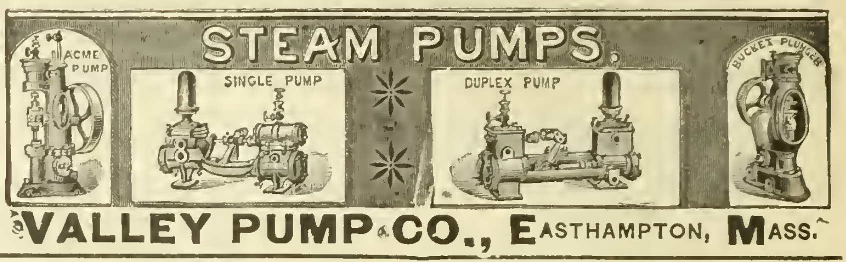

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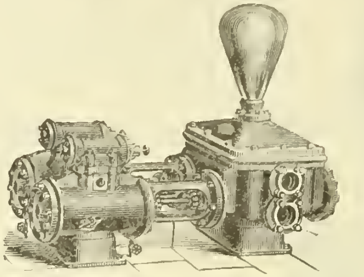

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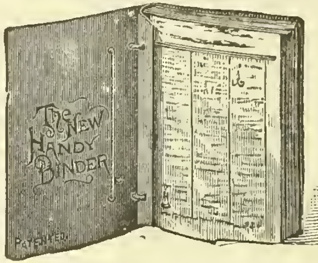

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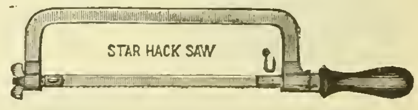

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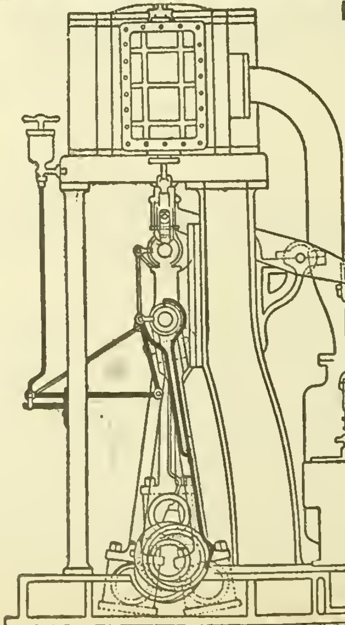

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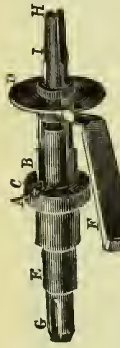

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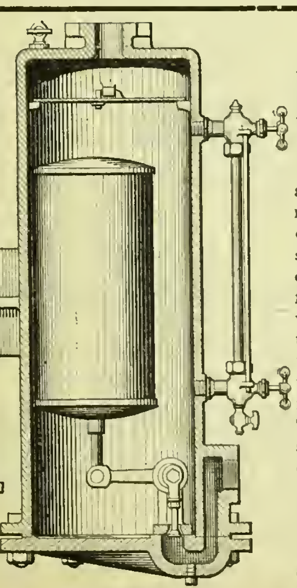

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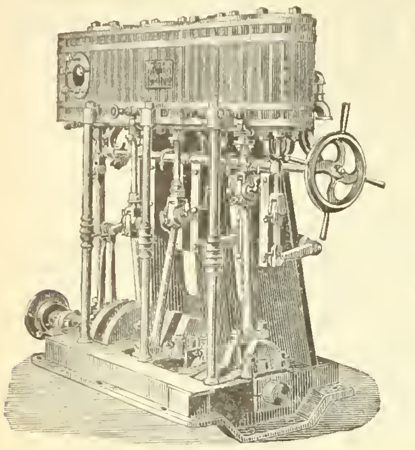

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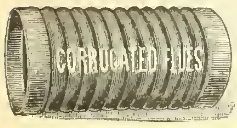

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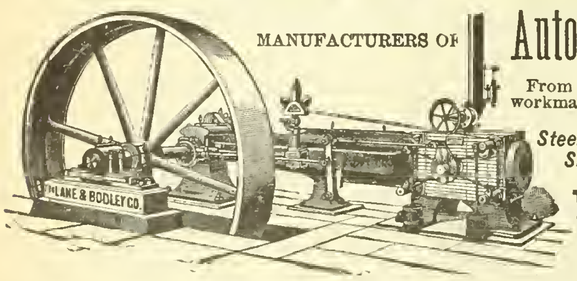
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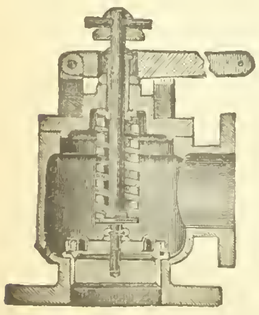

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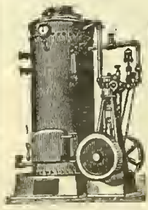

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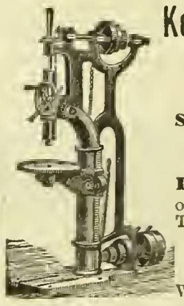

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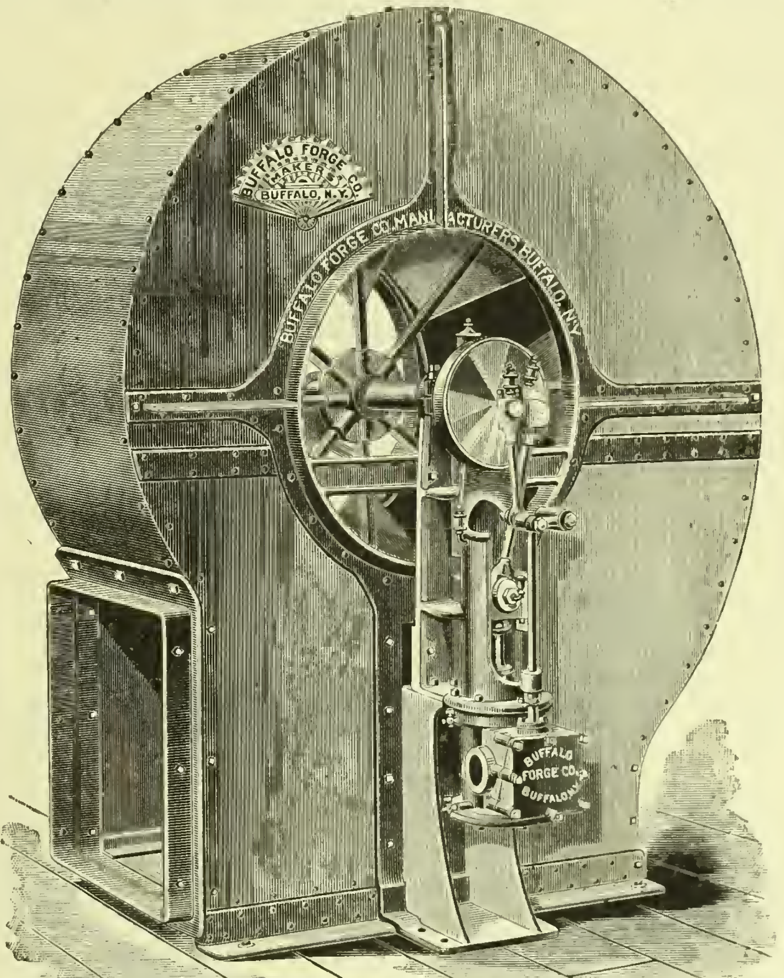
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Always cut off the end of a belt by your eye; then you will have a fine "dog's leg" when you come to lace the ends together!

SPONTANEOUS IGNITION OF COAL.

CARBON is one of those substances which possesses to an extraordinary degree the power of attracting and condensing gases upon their surface, this power varying with the state of division and density of the particular form of carbon used. The charcoal obtained from dense forms of wood, such as box, exhibit this property to a high degree, one cubic inch of such charcoal absorbing, of ammonia gas, 90 cubic inches; sulphuretted hydrogen, 55 cubic inches; carbon dioxide, 35 cubic inches; ethylene (olefiant gas), 35 cubic inches; oxygen, 9.25 cubic inches; nitrogen, 6.5 cubic inches; while certain kinds of coal also exhibit the same power, although to a less degree. The absorptive power of newly-mined coal due to this surface attraction varies, but the least absorbent will take up 1¼ times its own volume of oxygen, while in some coals more than three times their volume of the gas is absorbed. This absorption is very rapid at first, but gradually decreases, and is, moreover, influenced very much by temperature. The absorption is at first purely mechanical, and itself causes a rise of temperature, which, in the case of charcoal formed in closed retorts, as in preparing alder, willow, and logwood charcoal, for powder making, would produce spontaneous ignition if it were not placed in sealed cooling vessels for some days before exposure to air. The rate of absorption varies with the amount of surface exposed, and therefore able to take part in this condensing action, so that when coal or charcoal is finely powdered, the exposed surface being much greater, absorption becomes more rapid, and rise of temperature at once takes place. If charcoal is kept for a day after it has been made, out of contact with air, and is then ground down into a powder, it will frequently fire after exposure to the air for thirty-eight hours; while a heap of charcoal powder, of 100 bushels or more, will always ignite. It is for this reason that, in making the charcoal for powder, it is always kept, after burning, for three or four days in air-tight cylinders before picking over, and ten days to a fortnight before it is ground. In the case of coal, this rise in temperature all tends to increase the rate of the action which is going on, but is rarely sufficient to bring about spontaneous ignition, as only about one-third the amount of oxygen being absorbed by coal that is taken up by charcoal, and the action being much slower, tends to prevent the temperature reaching the high ignition point of the coal. Air-dry coal absorbs oxygen more quickly than wet coal.

◆

WE regret to see the *Age of Steel* giving currency to such fustian as this:—"The *American Mail and Export Journal* publishes the drawings and propositions of a new departure in the line of ocean steamships. The author of the model claims to be able to construct a ship that will cross the Atlantic between Queenstown and Sandy Hook in about three days and thirteen hours, averaging a speed of twenty-one to thirty-four knots an hour."

If any man can build a ship that will beat the '*City of Paris*' one knot per hour, he can sell it at a big price as soon as he does it; he need not talk about 23 knots or thirty-four knots. Our contemporary adds:

"There is both in theory and plans a guarantee of increased speed and stability, and the probabilities are that the record of our crack lines will be broken, and Atlantic transit be but a matter of a few days.

These increasing facilities for international intercourse are in touch with the civilization that is overlapping the old bounds of insular prejudice and making distrust and rupture less possible, by increasing intercourse."

Why say such things?

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MR. WELFARE is a steward on a Lake vessel. The idiotic puns made on the poor man must be hard to bear.

THE 'CITY OF PARIS' BREAKDOWN.

THE following account, which we believe to be perfectly reliable, is taken from a letter sent to us by a passenger whom we know to be an acute observer.

"The cause of the accident may come out some day; but at present I do not believe any living man knows why the low-pressure cylinder and its entire connections collapsed and disappeared utterly from view, buried under 20 ft. to 25 ft. of water in the engine-room. The first intimation was a sound as if an eccentric strap or a smaller piece of machinery had parted; the next sound was a crash as though the cylinder head had blown out, and then continuously the falling, crashing, and grinding sounds peculiar to the falling of an engine. . . . Later I learned that the starboard engine-room was flooded; that the low-pressure cylinder in its collapse and fall had demolished its condenser; that the injector outboard delivery pipes, with their Kingston valves and sea-cocks, had been destroyed; that the hydraulic engine, which was located in the engine-room to the rear and almost under the collapsed cylinder, had also been damaged, and that the bulkhead between the two engine-rooms had been cut through by the flying parts of the engine.

"It seems that immediately before the engine collapsed, during a period between seven to ten seconds at the furthest, a number of strokes of the piston, which is 113 in. in diameter, must have been made at a fearful velocity, and if, as is supposed, the connecting-rod was disconnected from the crank-shaft, it acted as a flail right and left. The two A columns supporting the cylinder are 14 tons in weight each; they have disappeared. The piston weighed 10 tons, the piston-rod 3 tons, the cross head 2 tons, the connecting-rod 7 tons, and the crank-shaft 14 tons. The 113-in. cylinder weighed 45 tons. The diameters of the other cylinders were 45 in. and 71 in., the stroke of all being 5 ft.

"There were at the time of the collapse seven engineers and firemen in the engine-room. God knows how they escaped. One was on the top platform reaching over to the tail rod; two at the starting handles on the middle platform, and the others about the room, which is 45 ft. in length and about 30 ft. wide. There are manhole plates leading from the engine-room compartment down into the water ballast tanks. The distance between the floor of the engine-rooms and the floor of the tank is 4 ft. 6 in.; the thickness of the engine floor plate is ⅝ in.; and the thickness of the ship-plates 1⅛ in.

"The starboard engine stopped itself after the collapse, but the steam was afterwards cut off. The port engine-room was filled in five to seven minutes. The chief source of peril was athwartship bulkhead forward of the engine-room. It exhibited a pulsation of 4 in., backwards and forwards, and shifted 2 in. from the engine-room bulkhead. Spar shores were used to stiffen it, strutted against the boiler. Three of these latter were emptied in the hope they would act as tanks if the compartment were flooded. There were 2,800 tons of water by actual measurement as soon as the compartments abaft the engine-room were filled, which afterwards increased to over 3,000 tons."—*Engineering.*

◆

TIME was when young lawyers frittered away years in establishing a practice, but that time has passed. A young lawyer who had just hung out a shingle had an experience recently which aptly illustrates the haste with which modernism scoots along. This young lawyer tried a case before a local justice, was called a liar by a witness, engaged in a fight with the vituperative person, was arrested, fined $25 for assault, and filed an appeal from his Honor's decision. All this within a single hour. Even in the practice of law the stage coach has been replaced by the lightning express.—*Chicago Mail.*

INSPECTORS' REPORTS, HARTFORD BOILER INSURANCE COMPANY.

DURING February, 1890, our inspectors made 4,652 inspection trips, visited 9,182 boilers, inspected 3,883 both internally and externally and subjected 548 to hydrostatic pressure. The whole number of defects reported reached 7,898, of which 739 were considered dangerous; 36 boilers were regarded unsafe for further use. Our usual summary is given below:

Nature of Defects.	Whole Number.	Dangerous.
Cases of deposit of sediment	380	16
Cases of incrustation and scale	708	51
Cases of internal grooving	39	7
Cases of internal corrosion	218	19
Cases of external corrosion	561	46
Broken and loose braces and stays	136	48
Settings defective	193	24
Furnaces out of shape	274	6
Fractured plates	213	72
Burned plates	128	33
Blistered plates	173	15
Cases of defective riveting	1,658	63
Defective heads	86	30
Serious leakage around tube ends	1,796	146
Serious leakage at seams	434	31
Defective water-gauges	215	20
Defective blow-offs	62	16
Cases of deficiency of water	6	4
Safety-valves overloaded	39	15
Safety-valves defective in construction	60	23
Pressure-gauges defective	259	26
Boilers without pressure-gauges	19	19
Unclassified defects	241	9
Total	7,898	739

◆

THE committee of Lloyd's Register in their latest rules for steamships have insisted upon considerable additions to the stiffening of transverse watertight bulkheads, more especially those bounding the machinery spaces. Whereas at one time these were stiffened by comparatively small angle bars, Lloyd's now require very stout angles, and in wide ships further support is given by vertical webs. Besides all this we would suggest the desirability of increasing the thickness of the bulkheads themselves. When the sea finds admission into a compartment and rises in it to the height of the water outside, the pressure against these wall-sided bulkheads is as great as that against the ship's side. But how different is the strength in the two cases. Just for a moment contrast the thick shell plating, stiffened with frames and reverse frames spaced 24 in. apart, with the thin bulkhead plating stiffened with frame size bars, and no reverse frames spaced 30 in. apart and further compare the relative strengths of the curved side and the flat bulkhead. It is no uncommon thing to hear shipbuilders, who object to many of Lloyd's requirements, say they believe transverse watertight bulkheads ought to be made stronger than they usually are. It is quite true that the transverse bulkheads of the '*City of Paris*' held out satisfactorily, and of course all is well that ends well. The '*City of Paris*' is, as everybody knows, an exceptionally strong ship: but supposing a breeze had sprung up and she had begun to pitch and surge and roll. How then would her bulkheads have stood? All right we believe, but if they did they would beat most other ship's bulkheads when subjected to the same test.—*London Engineer.*

◆

HERE's a queer suggestion that the editor of an electrical paper made recently: he said that criminals condemned to die by electrocution, as the term is, can easily insulate themselves by certain methods he gives. Well, if he knows so much about insulating the person, why does he not tell linemen how to prepare themselves to go aloft without danger?

◆

TIME on shipboard is marked by strokes on a bell. Thus, 12:30 A.M. is 1 bell; 1:00 A.M., 2 bells; 1:30 A.M., 3 bells; 2:00, 4 bells; 2:30, 5 bells; 3:00, 6 bells; 3:30, 7 bells; 4:00, 8 bells. At 4:30 the noise begins all over again at 1 bell. So, if you wake up at 4:30 on a dark morning and hear 1 bell, you can say it is only 1:30 and go to sleep again.

BREAKERS AHEAD!

We have tried in past issues of The Engineer to show vessel owners on the Great Lakes that they were not consulting their own interests in paying a fixed rate of wages to all, irrespective of experience, capacity or responsibilities; we have tried to show them that disrating engineers or ignoring their appeals for fair treatment as American citizens, is the worst possible policy for vessel owners, and our arguments seem to have reached some of the vessel owners, even if they have not convinced them, for one of them lately said to a reporter for a Cleveland paper:

> "Two months ago I would not have hesitated in saying that the coming season would be the most profitable for vessel and iron ore men of any for many years past, but to-day I would hesitate in saying that we would have as prosperous a season as last year. So many unlooked-for circumstances have arisen in the past few months, such as labor troubles, etc., that I think the most conservative owners must acknowledge that the prospects are not so good as we would like to have them. Strikes, like suicides, always come in a bunch, and there are so many different classes whose work directly affects marine interests that it is more than likely we will have trouble before the season is very well advanced. * * * The trouble with the engineers is liable to play an important part in the season's business. Barring the occurrence of any of the events I have mentioned, the prospects are encouraging.

Why should there be any trouble with engineers? The engineers themselves are not making any. They simply say they are not paid for their work and the owners do not show that they cannot pay any more. They merely say they will not. "Will not," is no argument, and vessel owners must not be surprised if engineers decline to accept it as an answer to their reasonable demands. It needs no sea lawyer to show that the wages paid American engineers on the Great Lakes are wholly inadequate, and very much less than is paid for similar service elsewhere. Marine engineers out of this port will average $100 per month the year round. Many get $125 per month, but not all, while Lake engineers are asked to work six months for $90 or say $100—which last they do not get—per month. Is there any wonder that they are dissatisfied? Vessel owners on the Lakes are not prudent men, for the Bible says: "The prudent man foreseeth the evil and hideth himself, while the wicked pass on and are punished." They have only themselves to blame for whatever befalls, for they have directly invited the disasters they anticipate.

◆

Some time ago we deprecated the teachings which have found favor with some, that engineers should acquire a knowledge of navigation, etc., with the view of taking absolute control of the ship. We pointed out that the present important and onerous duties of a chief engineer were quite sufficient to absorb the whole of his time and attention. Accidents, sometimes attended with loss of life, even now occur in engine-rooms; what might we not expect if a less careful supervision were exercised? Our marine engineers cannot be too highly trained—cannot be possessed of too much practical experience. In fact, a chief engineer of an ironclad, or of an Atlantic liner, is called upon to exercise the functions of a manager of an engine factory. Yet, where angels fear to tread, some benighted people will incontinently rush in!—*The Shipping World.*

◆

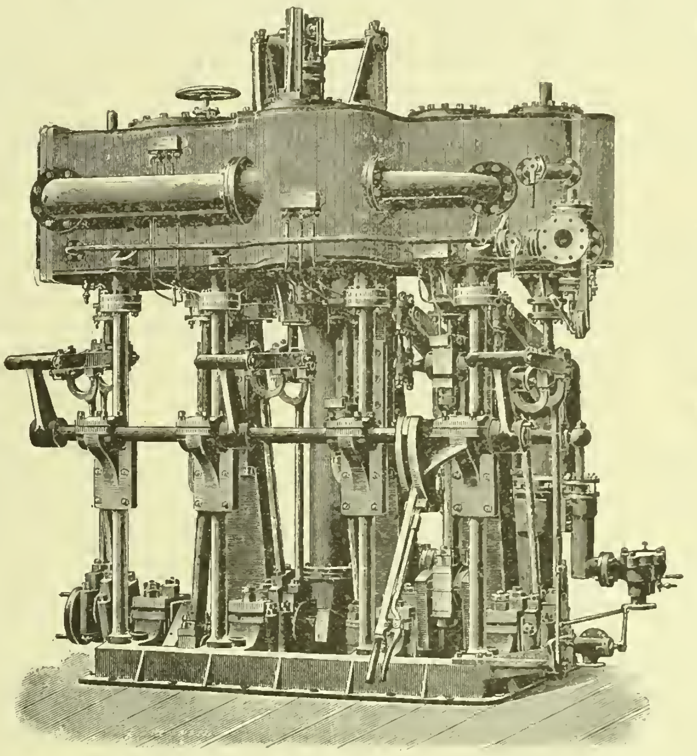
Recently a flagman's wife ran half a mile up the New York Central R. R. in her night clothes to flag an express train which would have otherwise been destroyed by obstructions on the track. The company gave her $100. A young woman out West did the same thing and saved an express train at the risk of her life. She also received $100. Thus it is shown that to save an express train from injury, to say nothing of the lives of passengers, is worth $100. Queer equity this!

DUTCH TUG-BOAT ENGINES.

The engraving taken from *Engineering*, represents a set of triple-cylinder engines made for a tug-boat by a firm of engineers in Holland, Messrs. Diepeveen, Lels, and Smit, Kinderdyk, for use in Dutch rivers and canals. The diameters of the cylinders are 9 in., 13¼ in., and 22¾ in., with a piston stroke of 14 in. As will be seen from the engravings, the valve of the medium-pressure cylinder is moved by a rod carried up between the medium and low-pressure cylinders. The object of this is to use the bar-type link throughout, this form having the advantage of being adjustable at all parts.

The valve gear is case-hardened. The high-pressure and medium-pressure valves are piston valves, while the low-pressure valve is of the common type. The low-pressure cylinder is provided with a valve to enable the engines to work either condensing or non-condensing, in which latter case the exhaust steam flows to the funnel. Very often recourse has to be had to this valve in winter, when the injection cock and pipe are frequently choked with ice.

The propeller has a diameter of 5 ft. 4 in., and a pitch of 6 ft. Steam is supplied to these engines by an ordinary marine boiler having a heating surface of 527 square feet and a grate area of 20 square feet. The working pressure is 150 lb. per square inch. On the trial trip the engines behaved exceedingly well, there being a total absence of hot bearings as well as vibration. The engines indicated 184 horse-power at 200 revolutions per minute.



◆

We had occasion to comment in a recent issue upon an article in *The Safety Valve*; in the course of this article we said that it was distributed by a boiler insurance company, taking our information from one of its canvassers and from its own columns, the March issue, we think. Our contemporary now says in a labored reply to our article:

> "In closing, we desire to call the attention of the managers of The Engineer to a misstatement of theirs regarding the ownership of *The Safety Valve*. It is a free and independent journal neither owned by nor conducted in the interest of any insurance company."

One of its canvassers informed us that several thousand copies were sent out, of each issue, by a boiler insurance company. If this is a misstatement, we correct it here.

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Do not play with small steam boilers—toy boilers—under the belief that they will not do much harm if they do burst. A quart of heated water under any ordinary pressure, say 50 pounds per square inch, has terrific energy when suddenly let loose; quite enough to wreck an ordinary dwelling house.

BUOYS.

The new thing in buoys is a bell buoy. The old style bell buoy consisted of a big saucer-shaped can, say ten feet across and four feet deep. From this arose a three-cornered derrick which supported a bell in its apex. Across the mouth of this bell was placed a table, and on the table inside the bell was a cast-iron ball four inches in diameter. The table was higher in the middle than at the edges, and the edges were cast in convolutions. As the waves rocked the can the ball went rolling and bobbing around, and every time it rolled it struck the bell, and the tolling warned mariners. Capt. Rodgers' new buoy has a can and a triangular derrick on it and a bell in the apex of the derrick much like the old bell buoy, but instead of one ball has three. These balls are placed in three tubes, twelve inches long, at equal distances about the circumference of the bell. Each tube points toward the bell, and when the ball is at the bell end of the tube it touches the rim of it. Therefore as the buoy rocks, the balls roll to and fro in the tubes, striking the bell with every roll.

It is not uninteresting to note that whistling buoys cost $1,200 each, and that, on the average, vessels rounding Point Judith destroy five of them every year by careless steering. The whistling buoy is a great heart-shaped can, with a long tube projecting below it into the water. The bottom of this tube is open, so that when the can settles into the trough of the sea the water rises and compresses the air in the can, and the air, on escaping through a suitable tube, blows a whistle. Then the can rises and the water sinks creating a partial vacuum in the can. Thereupon a valve on top opens and the air fills the can, to be once more expelled when the can sinks. Uncle Sam is now waiting for some one to invent a whistling buoy that will cost only $500 instead of $1,200.—*N. Y. Sun.*

◆

"Before the old strap rail was all taken up, the wooden rails upon which the straps were spiked got to be quite rotten and would not hold a spike, and the ends of the straps would often stand up from four to ten inches or more high. Those that stood from us we did not care about; when they pointed toward us and were very high, we would sit down behind the boiler head and wait results. Some of the old engines had a fender that caught the rail and turned it off into the ditch. We never stopped for them unless they got fast on the engines. An engineer on a ten-wheeler running at night was leaning out of a side window when a strap came in at the front window, just missed his shoulder and landed on the tank. It frightened him so that he quit the road in a short time and went to work on a farm. I once saw a strap rail come over the truck wheels and wind around one of the drivers of a passenger engine and leave it in the shape of a wagon wheel tire, and run 50 feet to the fence, and it did not make a scratch on the side rod. Freight cars had but few, if any, brakes; the telegraph was not used for running trains, and when trains were late they ran feeling for each other, and when running at night no light except a common tin hand-lamp. Engineers sometimes went too fast, and, when they wanted to stop, could not."—*National Car Builder.*

◆

Did you ever hear of a locomotive engineer whose ears deceived him? I have. An engineer is always expecting to hear the sound of a whistle. He listens so much for this sound that after years at the throttle, he will hear the sound of which I speak when there is none.—*Chicaco Tribune.*

What is a conductor always expecting to hear? The sound of a dollar—when there is none?

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

THIS INTERESTS THE TRADE.

Editors ENGINEER:

We have undertaken an extensive supplement to Webster's "Dictionary," the copyright of the 1859 edition having expired. This supplement will contain some 30,000 words, most of them *new* words. We wish to have it contain all new words which have such a place in common usage as to justify their insertion in a dictionary. Immediately after the issue of the supplement now in hand, we propose to organize a large force of American and English philologists to undertake the preparation of a complete International dictionary. This, of course, will be a work of years.

For use in the present supplement, would you do us the favor to send us a list of such new words as may occur to you, which are not to be found in Webster. The development of science, medical, chemical, etc., and other branches of knowledge, is endlessly bringing into usage such new words. These we wish to get hold of.

If any of what are known as "slang" words have, in your judgment, reached a precision of meaning, or a general usage, such as to merit a place in a dictionary, be so kind as to make mention of them, also, in your reply.

You will confer a great favor on us, if, in the next ten days, you will give us such lists of words as above referred to, *particularly along your special line of work.*

FUNK & WAGNALLS.

New York.

[We have no new words ourselves and are not patenting any at present, but all those who have can do a service by noting the above.]

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A BIG JOB.

Editors ENGINEER:

I desire to obtain a complete list of, and all information possible concerning all the manufactories in the United States employing one thousand men, or one thousand operatives and upwards, and expect to pay for the information. Will you please inform me the best and quickest way to obtain the information desired?

An early reply will greatly oblige,

JAMES E. MERRITT.

Minneapolis, Minn.

[We are unable to suggest any scheme to do this other than regular shop to shop canvassing in every large town, either by a corps of canvassers or individuals in such towns.]

◆

WHEN once coal in a cargo has fired on board ship, pumping in water is of practically no use, as the fire is, as a rule, near the bottom of the mass of coal, and the flow of the water is so impeded that in percolating through the interstices of the heated coal, it is converted into steam before it can reach the seat of combustion. The most effective way to apply water would be to have four 3 in. pipes laid along the floor of the coal compartments, about 6 ft. apart, these tubes having a $\frac{1}{4}$ in. hole bored in the upper side every foot or so, and each pair of pipes coming through the bulkhead, and connecting on to two 6 in. pipes passing through the side of the vessel, the sea-water being prevented from entering by means of screw valves. As soon as the alarm thermometer gave notice that heating had reached a dangerous point, these valves could be opened and the lower portion of the cargo drenched. This water evaporating rapidly, would give large volumes of water vapor, which, passing up through the heated coal, would lower its temperature.

◆

THE new steamer '*Majestic*' was thronged when in port by crowds of investigators, all of whom are interested in the latest development of naval architecture, a majority of whom hope to make passage in her some time during the summer. Captain Parsell's brief sojourn in the city has been a succession of breakfasts, luncheons, dinners and suppers.—*N. Y. Press.*

What has Mr. Seaton's, the chief engineer, sojourn been? A succession of taking up cylinder-heads, attending to his duty and general supervision of the department he is in charge of. That is the difference between a chief engineer and a captain.

NOTE ON THE ACTION OF LUBRICANTS.

IF we "feed" oil to a journal with an ordinary cup, which has its rate of feeding restricted so that the amount of oil supplied to the journal is no greater than is common —say, on a locomotive crank-pin, or in lubricating fast-running shafting, the resistance to rotation produced by friction will be from 3 to 20 per cent. of the force or load to which the rubbing surfaces are subjected. If the rubbing surfaces are in a very smooth condition the 3 per cent. limit is realized, but in proportion as the surfaces are less smooth the friction approximates to the greater limit. The average engine bearing, which is smoothed by natural wear unattended with considerable "end play," may be assumed to create a frictional resistance equal to from 5 to 10 per cent. of the total load on the bearings, that is, the "coefficient of friction" is from 0.05 to 0.10. The idea is somewhat prevalent that modern experiments with oil-testing machines have demonstrated that a journal wears *itself*, if run for a long time without mishap, to such a condition that a coefficient of friction of a fraction of 1 per cent. is finally secured. As a matter of fact the journals of testing machines which have given such a low coefficient have been nursed by long running under a flood of oil, to an exceptional state of smoothness, attainable only by maintaining a constant "end play," or reciprocating motion of the brasses, over a considerable fraction of the length of the journal. If such bearings are supplied with a restricted amount of oil, and the end-play motion stopped, the coefficient of friction immediately increases from the fraction of 1 per cent. to 3 or 4 per cent. In the case of railroad car bearings there is a natural realization of the low coefficients, because the supply of oil is superabundant, and there is an "end-play" motion which gives to the journal and brass a highly-polished surface, practically unattainable on engine bearings. —*Prof. J. E. Denton in Stevens' Indicator.*

◆

THE *Shipping World*, England, in a recent issue, while commenting upon the relative positions and prospects of deck and engine-room officers, says regarding the engineer: "Year by year increased demands are made upon his intelligence, his skill, energy, bravery and resourcefulness. He is environed by conditions which compel the development of the qualities we have named. He is a coming personage and will continue to occupy an increasingly good position in the labor market. He supplies a want, and is a greater factor in the world's activity than the general and the admiral. The engineer knows his importance; he demands public recognition of the same, and the least that should be done is to make him the equal of the master, and give him entire control of the engine-room, including power to enforce discipline among his staff."

◆

THE fastest run ever made between Philadelphia and New York was on March 10, by a special train over the Philadelphia and Reading Railroad and New Jersey Central Railroad, carrying Philadelphia and Reading Railroad stock to the New York Stock Exchange. The train left Philadelphia at 11:38 A.M., reached Bound Brook—59.2 miles—at 12:34, and Jersey City—90.4 miles —at 1.3 P.M. The 90 miles was made in 85 minutes, making the average speed 63.78 miles per hour. The 55 miles between Wayne Junction and Bound Brook was made in 50 minutes, at an average speed of 66 miles per hour. The maximum speed was 85 miles per hour. The train consisted of two passenger cars. The engine was of the "eight-wheel" type, with four-coupled driving wheels 68 in. diameter, and a four-wheel truck with 30 in. wheels. Cylinders, 18½ in. by 22 in. Weight, 89,750 lbs., with 60,780 lbs. on the driving wheels.

◆

COTTON stalk fiber has been successfuly carded and spun.

WHERE ARE THE FLYERS?

PERSONS who have invented flying machines—which do not fly—have attributed a part of their failure to their inability to obtain a metal sufficiently light and strong to construct their apparatus of, intimating that when they could obtain such a metal they would show us something. When aluminum got cheaper they would be very nearly, if not quite, ready to fly. Well, the aluminum is here, cheap enough for flying machines too, but where are the flyers?

A sheet of aluminum 12 in. square and 1 in. thick weighs 14.03 lbs. A bar of aluminum 1 in. square and 12 in. long will weigh 1.17 lbs. A bar of aluminum 1 in. in diameter and 12 in. long will weigh 0.918 lb. A cubic inch of cast aluminum weighs 0.092 lb. A cubic foot of cast aluminum weighs 168.967 lbs. A cubic foot of soft steel weighs 490.450 lbs. A cubic foot of wrought-iron weighs 480.474 lbs. A cubic foot of copper weighs 554.988 lbs. A cubic foot of ordinary brass weighs 524.610 lbs.

Taking the tensile strength of aluminum in relation to its weight, it is as strong as steel of 80,000 lbs. per square inch, ultimate strength. Comparative results in this way are tabulated below as taken from Richards' work on "Aluminum."

—	Weight of 1 cub. ft. in Pounds.	Tensile Strength per sq. in.	Length of a Bar able to Support its Weight in ft.
Cast iron	444	16,500	535
Ordinary bronze	525	36,000	9,893
Wrought-iron	480	50,000	15,000
Hard structural steel	490	78,000	23,040
Aluminum	168	26,000	23.040

Aluminum has about the tensile strength of cast-iron, with only about one-third of its weight, and casts equally as easily and successfully, and can therefore be advantageously used to replace cast-iron in the parts of moving machinery that have to be reversed or otherwise have their momentum checked, so that it seems to be especially adapted to flying machines, which have heretofore had their momentum, such as it was, seriously checked, not to say wholly impeded. Icarus was the first man who made a flying machine. It consisted chiefly of a pair of wings fastened to his shoulders by wax, but Icarus was a high-flyer and lost his wings by venturing too near the sun. If, now, some modern Icarus will do as well—he need not go too near the sun—and fly at all, he can find in aluminum a strong, light metal to build his machine of. We fear, however, that it will be a long day yet before flying machines obscure the light of the sun.

◆

A CHIMNEY of 450 ft. in height is being, or has been, erected at the Imperial Foundry, Halsbrucke, Saxony. Its interior diameter is 15 ft. 9 in. It has been designed for erection on a hill 260 ft. high, and will deliver at a height of 710 ft. above the works. The base is 39 ft. 4 in. square and 26 ft. 3 in. in height. This flue will be carried across the river, and will be 3,230 ft. in length. The whole of the chimney alone is to be of brick, and the estimated cost is, with the flue, about $60,000.

◆

DECK loads of cattle on board modern steamers are nasty things. The Ss. '*Holland*' left this port last week with such a load, and, with even the moderate swell of the harbor, she rolled like an egg on a plank. What she will do in a sea-way is not pleasant to think of. The '*Erin*' sailed from this port on December 28, bound for London, with a cargo of cattle, grain and tobacco. Since that day she has never been heard from.

◆

TWO employees of a city gas company went to look for leaks in an office building. Of course they knew it all, and took a naked light; one of them is in a hospital and the building was damaged $1,000 worth.

◆

THE '*City of Paris*' will not make another trip until November next.

BOOK NOTICES.

Electrical Engineering for Electrical Artisans and Students. By W. Slingo and A. Brooker. 307 Illustrations. Longmans, Green & Co., N. Y.

We have had frequent inquiries for a work which would give practical instruction in the care and use of the dynamo and the management of electric light plants, but up to the present time we have be unable to recommend any work of this character. The one under notice, however, comes very much nearer to the requirements of mechanics and engineers in charge of electric light plants than any other we have seen, and will, undoubtedly, be of service to them if carefully read and studied. We make a point of this latter expression, because it not unfrequently happens that persons buy useful works which contain the instruction sought for, but which the buyer does not obtain through his own fault. This fault is carelessly gleaning over page after page in the hope that something will strike his attention and become fixed upon the memory without any effort upon the reader's part. It is hardly necessary to remark that all knowledge must be bought by labor and pains, and that no work in existence contains specific directions to unscrew this, or pull down that detail in order to find out why a dynamo does not work, or the lamps do not give out light. It is necessary in all cases to know the principles which govern the action of electric lights, and these being impressed upon the mind, detection of faults follows easily. *Electrical Engineering* is a work well adapted to all engineers, and they can easily learn very much more than its price, $3.50, at a single sitting. Mathematical formulæ have been avoided in most cases; where they occur arithmetical solutions are given as well. A large portion of that work alludes to English and other systems, but American dynamos and lamps have a large space devoted to them. Sent free by mail on receipt of price.

Air Brake Practice. Being a description of the construction, objects sought and results obtained by the Westinghouse Automatic Air Brake, as well as complete directions for operating it under the many diverse conditions in daily practice. By J. E. Phelan, Assoc. Div. Superintendent N. P. R. R. Press of the *Locomotive Engineer*, 96 Fulton Street, N. Y.

This is a concise treatise on the subject of which it treats, intended for working engineers or locomotive drivers, and is lucidly written and fully illustrated. It is, we fear, a notch above the capacity of a great many, but there are some who are able to follow the author in his explanation of the principles involved. There are none who cannot get value from the work by carefully studying it. The author states in his preface that he is not trying to teach persons how to build or repair air brakes, but that it is intended for all who are interested in the operation of them in actual service on railways. To this end he gives a complete, indeed an exhaustive, description of the details and their action, accompanied by full illustrations; both are so clear that the runner may read and understand. This work is one that is greatly needed, and will doubtless meet with a ready sale among railway men.

Slide Valve Gears and Explanation of the Action and Construction of Plain and Cut-Off Slide Valves. By Frederick A. Halsey. New York: D. Van Nostrand Company.

This is a compendious work of 135 pages and index, which is clearly and concisely written, and fully illustrated by 79 engravings and diagrams. These last cover most situations and problems likely to arise in ordinary designing and engineering work, and will prove of great value to students and actual workers. Mr. Halsey has had opportunities for practical demonstration of his diagrams, and most of the propositions—if not all, in fact—are taken from engines actually constructed. We think it a valuable addition to an engineer's library. Price $1.50, free by mail.

MODERN BANKRUPTCIES.

It is clear that in the countless cases of bankruptcy which happen from day to day, to say nothing of peculations, embezzlements, forgeries, and other crimes by which confiding people are defrauded, the beginning and root of the trouble lies in personal overdrawing. This is a concise statement of an everlasting truth which cannot be too diligently heeded. A disregard of it, like the disregard of any other law of nature, is sure to be punished, though the punishment is not always distributed as it ought to be to satisfy our ideas of justice. If, when the profits of a business diminish, those who are conducting it cannot nerve themselves to reduce their personal expenditure in a corresponding degree, they must necessarily eat into their capital, and when this process once begins it must inevitably end in ruin. When I was a clerk with Messrs. Bissell, Littleby & Co., half a century ago, my employers never thought of relying on commercial agencies, as the custom is now, for information concerning a man's standing and responsibility. They got it from their own observation and inquiry, and carried it in their heads. They watched a man from the beginning of his career, and knew just how he was doing as he went along. His business skill, the character of his customers, the extent of his transactions, and the approximate amount of his annual profits were pretty accurately gauged, and credit was given to him accordingly. Above all, his habits of life were observed, and his family expenses were reckoned up, so that it was computed whether he was adding to his capital, barely holding his own, or falling behindhand. Nowadays everyone is, as it were, lost in the crowd and can do almost anything he pleases without its being found out. His creditors see him only during business hours and at his place of business; but where he is the rest of the time, what his occupations are, and how much he spends on himself and his family, become known to them, if they become known at all, only by accident, or when his accounts are overhauled by a committee to see how many cents on the dollar he can pay on the claims against him.—*Matthew Marshall.*

◆

Some instructive data concerning the comparative cost of incandescent lighting have been published. The average cost of maintaining a sixteen-candle-power lamp for twenty-four hours was shown to be 6.82 cents. A careful study of these data should be made by the owner of every office building, as it will unquestionably be to his interest to have an electric light plant installed with a view to giving his patrons the additional inducement of the electric light. The total yearly average cost per lamp in a modern office building should not exceed $4, including every possible expense, aside from electric or combination fixtures.—*Unknown Source.*

◆

This is the way leaks were stopped in the Hudson River tunnel:

> "The divers descended and after considerable time gave up the search. They succeeded, however, in closing the doors. Then engineer Moy used a novel method of finding the leaks. He secured a number of water rats and tied long pieces of oakum to their tails, caught in the middle by a piece of wire. The rats were then forced into the caisson through the air pumps. The rats, following the current of air, found the leaks and passing through the crevices left the oakum behind. This stopped the ingress of air sufficiently to enable the pumping to proceed with success."

Rats to pass through crevices would require to be about as thin as a trowel.

◆

Take a sponge of large size and sow it full of rice, oats or wheat, with the husks on if possible. Moisten the sponge and place it in a shallow dish, and the seeds will sprout before many days. When this has taken place, the sponge may be suspended by cords from the top of a window where the sun will enter. It will become a living mass of tender, delicate green, requiring a little occasional moisture.

FLESH AND BLOOD CANNOT STAND IT.

Stokers are hard to obtain, and the great transatlantic steamers find difficulty in obtaining them. There is a possibility that there will not be as many fast trips this summer as heretofore. This difficulty on foreign steamships can be only overcome by better pay, better accommodations and less hours. Parsimony is the cause of the scarcity of stokers.—*Marine Journal.*

Yes, in a general sense; but, after all, the trouble lies deeper, and this is in the craze for high speed on the sea. Men simply cannot endure the work. Flesh and blood cannot stand it for long. It is all very well for a few voyages, under the stimulus of whiskey and hurrah to make a few fast voyages, but engineers and firemen get none of the glory, while they do all the work. We would be pleased to see Mr. Deck Officer take a turn below in the engine-room, where it is 125 to 130 degrees, and share the responsibility entailed, not knowing what moment the cylinders—any one of them—were going to fall on him. Some of the directors might like to take watch and watch about in the fire-room and pass a few tons of coal, or fill up the furnaces every five minutes at the stroke of a bell, with someone behind them shouting all the while "Shove it back! Shove it back, damn you; you mutton headed son of a sea cook, shove it back!" These are horrible suggestions of ours, but, if every man connected with the management of a steamship had to work one voyage below in the fire-room or engine-room, they would tell people who shouted for quick passages to go to Davy Jones, where some of them will go, sooner or later. Flesh and blood cannot stand it, and this is a solemn fact. The strain of double duty is beginning to tell on men, as well as on the engines, and, when both are driven beyond their capacity, they protest by simply letting go all. Overdriven horses drop dead in their tracks; overdriven engines turn into scrap heaps; overdriven men simply clear out of the business.

◆

The poverty of the many is a perpetual menace. If we expect a prosperous and peaceful country the citizens must have homes. The more homes the more patriots, the more virtue, the more security for all that gives worth to life. The more real education, the less crime, and the more homes the fewer prisons.—*R. G. Ingersoll.*

This is nice for an after-dinner speech, but it does not seem to mean much when analyzed. The people who prey on property are those who do not want homes, and would not accept them as a gift. How are you going to deal with them? Force them into homes? You will not have a good time doing it.

◆

It has been found that the best apprentices in the Navy come from the lads picked up in the crowded streets of large cities, boys who sleep in and about the docks, and who hardly know what a square meal is. These little fellows, when sent aboard a warship, enter upon a new life, one better than they have ever experienced. In consequence they grow up as a part and parcel of the service afloat, looking upon shore simply as a place to have an occasional good time. On the other hand, the boys accustomed to good homes invariably tire of the service after six months or so.

◆

People who do not believe that dust will explode are advised to peruse the following: A dust explosion in a furniture factory of Indianapolis, Ind., caused a fire and the death of three boys. The engineer had legs broken and head crushed.

◆

Marine engineers can always be found in this city at 287 Hudson Street, No. 50, M.E.B.A. On the Lakes, owners can always get good men by telegraphing to Marine Engineers' Association, 17 Woodward Avenue, Detroit.

THE ENGINEER.

FORTNIGHTLY. . . . $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, APRIL 26, 1890. No. 9.

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Entered at the New York Post Office as Second Class Matter.

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THE RETORT COURTEOUS.

THE *Marine Record* of Cleveland, in reviewing our articles upon the situation on the Great Lakes as regards the treatment of its employees and engineers in particular by the Vessel Owners' Association, replies in a candid, conservative spirit. We have room for only one extract from it:

> "Among all classes of men, there must certainly be a divergence of opinion, while different methods of arriving at even the same or similar results will be found to exist. The spirit of the times regulates and adjusts difficulties which, viewed from a distance, may seem to be insurmountable obstacles. Accordingly we can see neither sense nor reason in antagonizing mutual interests, believing as we do that the law of supply and demand will go far toward maintaining the equilibrium of the scales, in which each are, perhaps unconsciously, weighed by those interested in the outcome. We scarcely believe that THE ENGINEER is desirous of condemning the action of any one body of men without a full and complete understanding of all questions and considerations involved. Suffice it to say, that capitalists are usually gifted with enough common sense to refrain from "biting their own nose to spite their face," and as we have said, matters pertaining to labor and capital are met better in the phase suggested by the more conservative element of an organization than by those who would become the rabid leaders of extreme changes."

The last paragraph of our contemporary's reply is a very sensible one, in which we heartily concur, but what precedes these remarks is hardly pertinent. We have no great faith in "the spirit of the times" regulating differences. We have much more faith in a common-sense statement of the matter at issue, which is simply this: The Vessel Owners' Association have met each year for four years past and tried to fix a rate of wages. The proposition was not even popular among the members of it. Some protested and said they preferred to fix their own rate, or, in other words, pay their men what they thought they were worth. The action of the Vessel Owners' Association on this kick was to appoint a committee of three to whom the objectors to the rule were to submit the wages schedule paid by them. If it was approved the kickers were allowed to pay such increased sums; if not—not. Now this is what we called "*Arbitrary Ruling*" in our editorial, and, with due courtesy to our contemporary, we see nothing in its reply to change our opinion. Some owners lost men who had been with them ten years, simply because they would not submit to the schedule, and because they were independent enough to assert their rights to living wages. We are not "rabid leaders of extreme changes," neither are the engineers on the Great Lakes. We ask our contemporary to point out any changes that engineers have made. The "extreme changes" come from the Vessel Owners' Association, who, for a fancied gain at the spigot of a few dollars paid in salaries, leak at the bung hundreds of dollars by creating false issues, and degrading men who have always had their interests at heart. It is not in human nature for anyone to manifest the same zeal when their income is reduced for the same service. Therefore we said that the Vessel Owners' Association was not wise in its generation, and had bad leaders. So it has, of the very smallest calibre. If they would create an office of supervising engineer or resident engineer, and get an honest, conscientious man to fill it, leave all to him, untrammeled, let him pay the wages each man earned, and hold him accountable for economic results, they would be very much nearer a dividend than they are when men who know nothing about engineers' duties, and care less than nothing for them personally, attempt to adjudicate affairs. What our contemporary says about supply and demand, does not apply. Supply and demand play strange tricks sometimes with those who put implicit faith in it as a maxim. The number of engineers who are idle in the winter is large, but it is much less in summer, and we have seen times when it was impossible to get men even in this port. Be this as it may, the covert insinuation that men enough can be had under the arbitrary ruling of the Vessel Owners' Association shows what these worthies have in view, but it will not avail them anything. No class of men whom they would intrust with their property will put up with the injustice we have complained of and protested against. Good men are always scarce, and it is unjust to them to rate them on a par with the idle and dissipated, who are willing to work for anything. All we say now is that we hope wise counsel will prevail on both sides.

◆

THE 'CITY OF PARIS' DISASTER.

IT is now stated authoritatively that the accident which occurred to the '*City of Paris*' was, primarily, the breaking of the shaft inside the stern-tube, leaving the engine wholly disconnected from the propeller. This being the case, the rest is easily accounted for: the great engines, wholly unloaded, whirled around for a few seconds at a frightful velocity, with results that are now known to have resulted in the total destruction of the low-pressure engine. Why it alone was destroyed is as incomprehensible as all the rest of the disaster, and that no one was injured in the cataclysm of flying iron and steam is certainly marvelous. There were six persons in the engine-room at the time of the accident, and one of them was standing right under the low-pressure cylinder when it let go. Another man was on the upper platform lubricating the tail-rod, when the end of all things came for the low-pressure engine. Only an engineer can comprehend the condition of things in that engine-room for a few seconds. With the destruction of the low-pressure engine the high-pressure and intermediate cylinders were open to the atmosphere, and for a few seconds exhausted directly into it. Even if a man had had his hand upon the throttle at the moment the shaft gave way, and had closed it tightly, the steam pipe and steam chests would have been full of live steam, which would have exhausted into the engine-room. As a matter of fact, no one was at the throttle, and therefore still greater volumes of steam were liberated. It would take at least three minutes before the stop valves and throttle could be closed, the links thrown into mid-gear, and the boiler cut off from the engine-room, and this would be unprecedented dispatch, supposing no one lost his head or was at all rattled by the situation; but three minutes in an atmosphere charged with steam at 358 degrees is a lifetime, and how any man of the six escaped to tell the tale of their disaster is past understanding. During the collapse of the low-pressure engine anything might have happened, and several very serious things did happen, as is shown by the shipping of some thousands of tons of water and the total disablement of the vessel.

Even with this meagre information, sufficient is known to class the accident as one of the most extraordinary that ever happened, and it is certain that it could not have been foreseen or guarded against in any way. The management in the engine-room and the precautions taken show that cool, capable, level-headed men were in charge, who acquitted themselves with credit to the profession they represent. We shall publish fuller reports as fast as they are made public.

◆

UNLAGGED BOILERS ON FAST STEAMERS.

SERIOUS difficulty is experienced by the fast passenger vessels on the Atlantic, and on all modern steamers, for that matter, having closed fire-rooms, in getting men able to stand the work. The trouble lies in the high pressures carried, 150 pounds of steam, and the temperature thereof, which is very much higher than the pressures carried twenty years ago. Steam at 150 lbs. per square inch is 358° F., and boilers with this pressure on are tremendous radiators which roast out everything in their vicinity. If they were fully protected with lagging of the most approved sort on every surface, very much of the discomfort would be removed, and much less coal would be used on the round trip, but lagging boilers costs money in the first instance, and not many of them are protected as they should be. Some vessels are worse than others as regards the condition of fire-rooms, but all are bad enough, particularly when the wind is aft or following the ship, then the fire-rooms are perfect hells.

Chief Engineer Sewall, of the new steamer '*Majestic*,' said lately on this subject: "I can account for the falling off in good men only through the adverse circumstances under which they have to fire nowadays on the fast ships. I do not believe the pay has anything to do with it. Men will not go to sea for any sum when they learn that their work is to be confined to air-tight fire-rooms and inclosures stifling with heat. Unless some remedy is found, it is my opinion that inside of three years attempts will no longer be made to drive machinery to its utmost. Ships will be run at moderately high speed, or at least under conditions which will make it an inducement for men to work in the fire-rooms."

We do not see clearly what the speed has to do with the heat in the fire-room. Steam of 150 lbs. per square inch is just as hot at ten miles an hour as it is at twenty miles per hour, and the real source of the heat and discomfort is the steam in the boiler. Men would not have to handle so much coal at ten miles per hour as they would at twenty miles per hour, but they would be just as hot for the time being. The remedy, it seems to us, lies in better protection of all steam surfaces, not in forcing cold air in upon uncovered surfaces. With the present condition of boilers in most ships, a rapid circulation of cold air would carry off a great many tons of coal which had done no work whatever.

◆

WATER PURIFICATION.

It is surprising what stuff railroads and private individuals will put into their boilers to make steam from. They know quite well that the water is full of mineral substances in solution, but they continue to use it to the injury of the boiler and loss in coal bills. Once in a while they make a feeble attempt to remedy matters by writing to parties familiar with the subject and able to effect a cure for the trouble, then they speedily forget all about the matter, and do nothing more. There is no difficulty in purifying the worst water and rendering it available for steam purposes, but it requires special treatment and simple apparatus. It costs a little money, too, not much but some, but it does not cost so much to have pure water as it does to have impure. This is a matter of great importance to steam users, and they should adopt some system without delay.

◆

National President John H. Galwey, M.E.B.A., has lately visited all Lake ports as far as Duluth, where he installed an association. All are flourishing, but Lake associations adjourn until the 15th of December, as none of the members can attend. He will shortly visit the Pacific Coast, and look up all the associations there, after which he will pay his respects to the Atlantic sections. Brother Galwey is working hard for the good of the order.

◆

Not many years ago chief engineers on the Great Lakes got $130 per month, and then their duties were very light, compared to what they are now. Steam is more universally used for electric lights, cargo engines, getting the anchor, steam steering, etc., and all these have to be looked after by the engineer. Yet he gets $100 now, where he got $130 for half the work. The *Marine Record* is respectfully requested to copy this item.

◆

The New York office of the Roberts boiler works will be removed, on May 1st, to the Telephone Building, 18 Cortlandt Street.

FAMOUS AMERICAN ENGINEERS. No. 9.

MIERS CORYELL.

Miers Coryell was born in Pennsylvania, but has been a resident of this city for the greater part of his life. He learned his trade at the establishment now so well known as the Morgan Iron Works, but at that time the firm was T. F. Secor & Co. After serving a long apprenticeship he became draughtsman in the works, and so identified himself with the interests of the establishment during the following years, that when a change of the firm introduced Mr. Geo. W. Quintard as business manager, in place of T. F. Secor, retired, Mr. Coryell became the superintending engineer of the Morgan Iron Works, which was the new name under the changed management.

The business energy of Mr. Quintard soon became apparent in the increasing business of the Works, and Mr. Coryell's position became one of great responsibility, not only taxing his mechanical ability to the utmost, but requiring the exercise of the highest executive ability to manage the labor in the Works successfully and profitably.

This establishment took high rank at that day among the manufactories of engines and boilers in this country, which was due to the union of the mechanical skill of Mr. Coryell with the superior business ability of Mr. Quintard.

Mr. Coryell has been identified with the progress of steam machinery and boilers for so many years that special mention of the ships turned out by him is hardly necessary to our readers; he keeps himself well informed about engineering matters and is familiar with all that transpires both abroad and at home by personal observation and inspection. Miers Coryell retired from the Morgan Iron Works in 1865, and went into business on his own account at the Dry Dock Iron Works, and also the Quintard Iron Works, of which he was one of the promoters and founders. His business engagements have carried him all over the world, including some years in China, where he built several large steamers with Chinese mechanics, whom he also employed in the re-erection of vessels which were built here (also in England and Scotland) and taken apart for shipment.

The leading characteristic of Mr. Coryell's engineering work and designs has always been to produce mechanism in connection with steam engines which shall develop the highest expansive effect in their working; he has for many years been closely allied to and in accord with the engineering ideas of the late Edward N. Dickerson, with whom he enjoyed a close friendship; some of the best examples of Dickerson's expansion system have been produced upon engines designed and built by Mr. Coryell.

He is a frequent passenger across the Atlantic on the ocean greyhounds (so-called), and is credited with spending a considerable portion of his time in their engine and fire-rooms during these passages. Mr. Coryell's particular attention for a few years past has been directed towards tubulous or coil boilers, he being a firm believer in their adoption in the near future, and the path made easy to reach 300 lbs. initial pressure in steam engines, when he hopes to see accomplished in their cylinders the expansion of steam to 32 volumes; of course with puppet valves as a necessary adjunct.

Mr. Coryell, when a young draughtsman, assisted in the work of preparing drawings for the 'Stevens Battery,' and years subsequently, when the battery was offered to our Government, he advocated with all the influence he could exert, its acceptance; his admiration for this great war vessel, and his favorable professional opinion of it as such, was very highly appreciated by the late Edwin Stevens, during the time he was vainly endeavoring to have it tested and accepted by our naval authorities.

During the civil war, Mr. Coryell was associated with others as a board to decide upon important engineering questions which had arisen relating to the economy and efficiency of the machinery of war vessels, and more recently he was a member of the Naval Advisory Board (created by a law of Congress), during Hon. W. E. Chandler's administration of the Navy Department. This board designed the '*Dolphin*,' '*Boston*,' '*Atlanta*' and '*Chicago*,' which were blockaded and bombarded by the Whitney administration for four years, only to be released by the present enlightened Secretary of the Navy, and sent abroad with the official designation of "Squadron of Evolution."

◆

BOGUS INVENTIONS.

There are a lot of alleged trade papers published in this country, whose contents consist of just such silly items as that here appended:

> "A journal devoted to new inventions gives an account of an alarm for hot journal bearings, the invention of one Christian Agerskov, of Copenhagen, Denmark. The idea embodied is to arrange an explosive, in association with certain chemicals, so that a certain degree of heat will cause the explosion and warning before the heat reaches a destructive stage. A small sheet of sheet metal—something like a cartridge shell—is filled about half way to the open top of the explosive. A paraffine globular capsule, hollow inside, is filled with sulphuric acid and sealed. This globule is laid on top of the explosive, and a mixture of chlorate of potash and sugar is filled in all around it; then a stopper or plug of cork or rubber is put in, sealing the cartridge. A hole is drilled in the box or bearing and the cartridge set in. Should the bearing run dry, the heat will melt the paraffine capsule, letting the sulphuric acid come in contact with the chlorate and sugar mixture, which will immediately explode the cartridge, causing a loud detonation and a light and volume of smoke, so that attention is immediately called to the condition of the bearing. This invention has wonderful merit and has been patented in many of the European countries.

This invention has no merit whatever, and is an utterly useless contrivance for any purpose. Engineers have no use for torpedoes or bearings that explode and scare everybody to death: they find out long before the chlorate of potash does that a bearing is hot and prevent it from getter hotter. Can chlorate of potash do that? What is wanted more than explosive torpedoes on bearings, is a good refrigerant which will take the heat out of a shaft or crankpin 24″ diameter.

◆

A subscriber in Philadelphia propounds the old cannon ball question which has now passed into history as one of the most popular of modern inquiries. A cannon ball fired backward from a train falls where it was fired, with relation to the earth. With relation to the train it acts just as any other cannon ball would.

Foreign and Domestic Trade Literature.

ECONOMY OF COMPOUND AND TRIPLE ENGINES.*

In comparing the economical working of compound and common engines, it is necessary to use the same pressures of steam, the same quantity, and put it through the same number of expansions.

Let us assume the diameter of cylinders of a compound engine to be 30″ h.p. and 60″ l.p., steam pressure 80 lbs. per □″, cut-off at half-stroke in h.p. cylinder, and about the same in l.p. cylinder.

We will now find the ratio of expansion of steam, that is, compare the volume of steam admitted into the h.p. cylinder to the volume which it will occupy by the time it fills the l.p. cylinder.

Steam cut off at half-stroke will, by the time it expands and fills the whole stroke, occupy twice its volume; this is called two expansions.

Ratio of cylinders $=60^2 \div 30^2 = 4$.
Therefore $2 \times 4 = 8$ expansions of steam.

We will now trace the initial and terminal pressures in the cylinders; in the h.p. initial 80 lbs., and terminal 8 lbs.; in l.p. initial 8 lbs., and terminal 3½ lbs. absolute.

Temperature of steam 80 lbs. is 324°F.
Temperature of steam 8 lbs. is 236
Fall of temperature in h.p... 88

Temperature of steam 8 lbs. is 236
Temperature of 3½ lbs. abs. is 150
Fall of temperature in l.p.... 86

In the common engine we must use a cylinder 60″ diameter, the same as l.p. of compound, and steam to be cut off at one-eighth of the stroke.

Initial pressure of steam 80 lbs., and terminal pressure 3½ lbs. absolute.

Temperature of steam 80 lbs. is 324°F.
Temperature of 3½ lbs. abs. is 150
Fall of temp. in common engine 174

From which we see that the same total fall of temperature takes place in the compound as in the common engine, but with this difference, that part is in the h.p. and part in the l.p. cylinder. So that with more uniform temperatures in the two cylinders there cannot be so much condensation of steam at the commencement of stroke as there will be when there is a great variation of temperature, such as that in the common engine.

We say the compound engine is more economical than the common one, because there are two cylinders to obtain the necessary expansions of steam, therefore the temperature throughout the stroke is more uniform, and less condensation takes place.

In the common engine there is only one cylinder to obtain the expansions, therefore a greater variation of temperature, consequently a greater amount of condensation of steam when it is admitted amongst the cooler steam, cooler surface of piston and cylinder sides.

The following method will give an approximation of the losses:

$\frac{88 \times 100}{174 \times 4}$ = 12.64% of condensation of h.p. compared to common engine.
$\frac{86 \times 100}{174}$ = 50 (nearly) % of condensation of l.p. compared to common engine.
☛ $50 + 12.64 = 62.64\%$ compared to common engine.
$100 - 62.64 = 37.36\%$ saving by compound engine over common engine.

In the case of a triple-expansion engine compared to the common one, I will take as an example the actual dimensions of a triple engine with three cranks, h.p. 28″, i.p. 46″ and l.p. 75″ diameter, stroke 4 ft. 6 in., steam pressure in boiler 170 lbs. per square inch, cut off at half-stroke in h.p. engine. By measurement from indicator diagrams, the h.p. has an initial pressure of 160 lbs., and terminal pressure 50 lbs. per □″. I.p. initial pressure 50 lbs. and terminal pressure 7 lbs. L.p. initial pressure 7 lbs. and terminal pressure 3½ lbs. absolute.

Temp. of steam at 160 lbs. 371°
Temp. of steam at 50 lbs. 298°
Fall of temp. in h.p. ... 73°

Temp. at 50 lbs............298°
Temp. at 7 lbs............234°
Fall of temp. in i.p...... 64°

Temp. at 7 lbs.............234°
Temp. at 3½ lbs. absolute.150°
Fall of temp. in l.p...... 84°

In the common engine using the same pressure and same quantity of steam, and passing it through the same number of expansions.

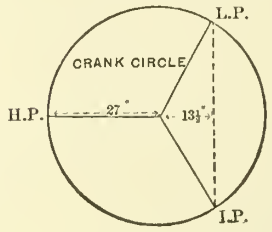
Cut off at half-stroke gives two expansions.

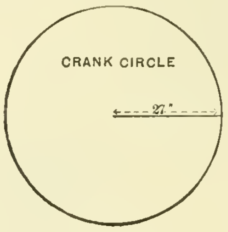
$\frac{75^2}{28^2} = 7.17$ Ratio of h.p. and l.p. cylinders.
$7.17 \times 2 = 14.34$ Expansions of steam in triple.

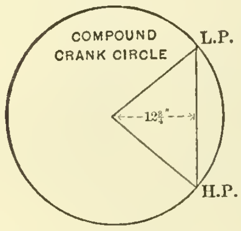
Therefore the steam in common engine must be cut off so as to give the same expansions, the diameter of cylinder to be 75″, same as l.p. in triple and the same stroke.

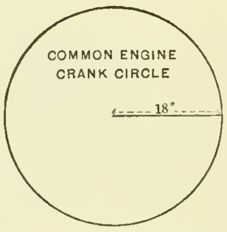
The initial pressure will be 160 lbs. and terminal pressure 3½ lbs. absolute.

Temp. at 160 lbs...........371°
Temp. at 3½ lbs. absolute 150°
Total fall of temp.......221°









We will now find the respective values of the temperature ranges compared to that of the common engine.

$\frac{75^2}{46^2} = 2.66$ Ratio of i.p. to l.p.
$\frac{75^2}{28^2} = 7.17$ Ratio of h.p. to l.p.
$\frac{73 \times 100}{21 \times 7.17} = 4.6\%$ loss in h.p compared to common engine.
$\frac{64 \times 100}{2212. \times 66} = 10.9\%$ loss in i.p. compared to common engine.
$\frac{84 \times 100}{221} = 38.0\%$ loss in l.p. compared to common engine.
$38 + 10.9 \times 4.6 = 53.5\%$ fall of temp. in triple compared to common engine.
$100 - 53.5 = 46.5\%$ in favor of triple expansion.

As triple engines on an average burn 1½ lbs. coal per hour, per i.h.p., we may use the following to approximate the amount for a common engine:

53.5:100: :1.5 lbs. to 2.8 lbs. per hour, per i.h.p., by common engine.

In the triple engine we have three cylinders to obtain the expansions of steam, therefore a more uniform temperature of steam throughout the stroke than that obtainable in a common engine where all the expansion is done in one cylinder, from which we conclude there is less condensation of steam and more economy in the working.

We will now proceed to show the economy in respect to the dimensions of working parts; viz., piston rod, connecting rod and shaft.

Assuming that the compound engine and the common one have a piston stroke of 36″, their crank centers are each 18″.

The effective leverage of common engine's crank is 18″, and the effective leverage of compound engine's cranks is 12¾″, which will be seen from the above sketch.

Taking the pressure on h.p. piston at 80 lbs. and on the l.p. at 15 lbs. gross.

We will use area of pistons in circular inches.

$30^2 \times 80 = 72{,}000$ lbs. on h.p. piston.
$60^2 \times 15 = 54{,}000$ lbs. on l.p. piston.
126.000 Total lbs. at 12¾″ leverage.
$126{,}000 \times 12.75 = 1{,}606{,}500$ in. lbs. twisting moment on shaft.

Taking the pressure on common piston at 95 lbs. gross.

$60^2 \times 95 = 342{,}000$ lbs. on piston.
$342{,}000 \times 18 = 7{,}956{,}000$ in. lbs. twisting moment on shaft.

The strains throughout on the compound engine being considerably less than on the common engine, much lighter material may be used for same power of engines.

Proceeding to the triple and common engines in respect to economy of material.

The triple engine has a stroke of 54″, and the common one the same.

The effective leverage of common engine crank is 27″. The effective leverage of h.p. crank is taken as 27″, the i.p. and l.p. each 13½″.

The pressure on h.p. is 160 lbs., on i.p. 45 lbs. and l.p. 8 lbs., for the positions of cranks.

$28^2 \times 160 = 125{,}440$ lbs. on h.p. piston.
$125{,}440 \times 27 = 3{,}386{,}880$ in. lbs. twisting moment.
$46^2 \times 45 = 95{,}220$ lbs. on i.p. piston.
$75^2 \times 8 = 45{,}000$ lbs. on l.p. piston.
140,220 Total lbs.
$140{,}220 \times 13.5 = 1{,}892{,}970$ in. lbs., by i.p. and l.p. combined.
$1{,}892{,}970 \times 3{,}386{,}880 = 5{,}279{,}850$ in. lbs. total T. moment on triple engine shaft.
$75^2 \times 175 = 984{,}375$ lbs. on common piston.
$984{,}375 \times 27 = 26{,}578{,}125$ in. lbs. T. moment on common engine shaft.

The triple showing lesser strains throughout, lighter material may be used.

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MANAGEMENT OF HIGH PRESSURE MARINE BOILERS. No. 1.

With the high pressure steam now used, it is obvious that great attention must be given to the condition and management of boilers, and it should therefore be our greatest care to subject them to careful internal examination as frequently as possible, noting any sign of weakness or corrosion, and getting them protected or strengthened as promptly as possible, keeping them clean, preserving a thin scale over those parts exposed to the direct action of the flame, and using all means in our power to avoid preventable accidents.

Accidents to boilers have frequently occurred during the past few years, many of which have been occasioned solely by dirt. This in some cases being common salt, in others ordinary scale which has been allowed to accumulate to too great a thickness, whilst in other cases it appears to have been a dark gluey substance, apparently composed of oil from the cylinders mixed with mud or other dirt from the feed water.

Steam, as we are all aware, is composed of pure water, and so long as pure water is supplied for feed, and an equal weight of steam only is used, so long will the composition of the water in the boiler remain unaltered.

If originally fresh, it will remain fresh, if originally salt and of any particular density, it will remain salt and at that particular density. If, however, an impure or salt water is used and nothing but steam is taken from the boiler, the whole of the impurities, be they salt, mud or anything else, will remain in the boiler, and consequently the condition of the boiler water will continually tend to become more and more dense and impure, and in time will become unfit for use.

Now, the feed water at sea can never be absolutely pure, while often it is very far from such a condition, and as of necessity a small quantity of sea water must be continually supplied to the boilers, although this supply may be very small in proportion to the whole amount of feed water used, yet the aggregate amount on a long voyage would be very great. It is a well-known fact that deposit takes place much more rapidly with the high pressure, now generally used, than with the lower pressure formerly used, and Mr. Parker, chief engineer surveyor at Lloyd's, has recently shown us that the extra feed required per 1,000 h.p. indicated amounts to one ton of water per day, and if this water has to be taken from the sea no less than 2 cwt. of solid matter must be deposited every day. It can, therefore, easily be seen how detrimental such treatment must be to boilers engaged on long voyages.

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*An abstract of a paper read at the Marine Engineers' Institute, South Shields, by W. E. Thompson, Teacher of Engineers, North Shields, Eng.

So far as the effects of the solid matter contained in sea water are concerned, we may consider them to consist of two distinct kinds of substances. One portion, being chiefly common salt, together with a little chloride of magnesia, is very soluble in water of any temperature, and sea water must be evaporated to a very great extent before this portion is separated or deposited. The other portion is principally sulphate and carbonate of lime, which are very sparingly soluble in cold water, and almost insoluble in water in the temperature at which steam is formed at the high pressure now used.

Therefore, in any quantity of sea water put into a boiler and raised in temperature to boiling point, the soluble portions of the solid matter still remain dissolved, but the whole of the lime salts are deposited in a solid form, and these salts thus deposited constitute the greater portion of ordinary boiler scale.

If from any cause sea water must be used as feed water, two courses are open to us: we may allow matters to take their course and the whole of the salt put into the boiler remain there, when the lime salts will become deposited in the boiler, the soluble salts remaining in solution and the water become denser and denser to the point at which it becomes saturated; or we may, by brining or blowing off, check the density of the water from exceeding any desired amount by discharging from the boiler, when this density is reached, just so much saline matter as entered with the feed. For instance, it is not thought prudent to allow the boiler water to become of greater density than twice the saltness of the sea. Then in order to do this, for every gallon of sea water introduced into the feed, after this density has been reached half a gallon of boiler water must be blown out.

With treatment the boiler water does not become abnormally salt; but as blowing out has been resorted to, the waste has also to be made up with sea water, and thus more sea water has to be used altogether than if the first course had been practiced.

Now the whole of the lime salts of the sea water must in either case be left in the boiler, so that by adopting the last-mentioned method a greater quantity of scale will be formed in the boiler.

The apparent anomaly that in cases where it is necessary to use salt water with the feed, the salter the water is maintained in the boiler the cleaner it will be found, is thus seen to be due to the fact, that by allowing the boiler water to become very salt a less total amount of sea water has to be used; but it must be remembered that it is possible to carry this practice to a very dangerous extent, so that a degree of saltness may be reached which in itself will be more dangerous than an accumulation of thin hard scale. Assuming the water has been allowed to become so salt that an actual deposition of salt has taken place, it will be obvious at once that as this salt is so very easily soluble, a very limited amount of blowing down and replacing with sea water will sufficiently freshen the boiler water to re-dissolve the deposited salts. And here let me say, that by neglecting the frequent use of the salinometer an engineer does not know how near to danger point he may be at any moment.

(*To be continued.*)

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PERSONS sometimes speculate as to whether animals reason or exercise judgment in certain cases. They certainly do. All animate creatures know good food from bad, danger from safety, and cautiously consider every action before deciding. What can man do more than this, except talk?

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WHEN a man guilty of some dereliction of duty begins his explanation with a slowly enunciated "Well—the—fact—is," look out for him. He is ransacking his brain for the most plausible lie.—*Texas Siftings.*

LOSS BY CONDENSATION AND RE-EVAPORATION IN MARINE ENGINE CYLINDERS.*

THE introduction of the compound engine was a distinct gain over the ordinary condensing engine, and, steps being ultimately taken to carry the principle further, the experience of the last twenty years has resulted in our having arrived at the quadruple engine, through a series of added cylinders and increased pressures, showing, however, a decreasing rate of gain in efficiency. A further advance, however, is necessary, and the only question is the direction in which it may be found.

In the present paper the author does not propose to do more than suggest a direction in which a considerable gain may be secured without multiplying expansions or increasing the already high pressures.

Condensation and re-evaporation in the cylinders has long been recognized as a great source of loss, and it was generally held that, by breaking up the operation of expansion into two, three, or four cylinders, we had overcome the difficulty. This, however, is still doubtful. The action of the steam on the walls, cover, and piston of the cylinder, has received very able investigation; but the author is not aware that the ports, and what occurs within them, have had their full share of attention. The conduction of heat into and out of a metal surface is dependent upon the rate of circulation of the heating or cooling medium over it, and this circulation is of greater moment as the difference of temperature between the two becomes less.

Now the steam passes into and out of the cylinder without actually circulating over its surfaces; the vapor in contact with the cylinder surfaces practically remains so, or at most cannot possibly pass over them at a greater speed than that due to the piston speed, while in the case of the ports the whole volume is passed through an area (which has generally a very large proportionate perimeter) at about ten times the piston speed. The circulation over the cylinder surfaces is practically nil, and conduction is still further impeded by the condensed water clinging to them, but it is extremely rapid and efficient in the ports, where its high speed also maintains the surfaces clear of water, and in the best possible state for parting with or taking up heat; better conditions, in fact, could hardly be obtained for promoting condensation or evaporation. While the cylinder walls probably do not rise much above or fall much below a certain mean temperature, each port gets thoroughly heated up to the initial and then thoroughly cooled down to the terminal temperature at every revolution. Steam jacketing may do a great deal to lessen condensation and re-evaporation in the cylinder, but it obviously cannot deal with the serious mischief which thus occurs in the ports, and it may not be too much to say that although the extent of the cylinder surfaces exceeds that of the ports, it is in the latter where the heaviest losses occur. There can be no doubt that, especially in the quadruple engine where this heating or cooling action takes place sixteen times per revolution, we have a state of things which demands a remedy, and any successful attempt to eliminate it would be amply repaid by increased efficiency. If these losses could be eliminated almost entirely, there would obviously be no necessity to carry the compound principle further than the two-cylinder engine, unless for the purpose of obtaining the more equal turning moment given by three cranks. In an unjacketed cylinder cutting off at 75 per cent. of the stroke, it has been found that the quantity of steam condensed amounts to about 11 per cent. of the whole quantity admitted to the cylinder. The range of temperature to which the horse power ports of a triple-expansion engine, working at 16 lbs., are exposed are approximately as follows: H. p. 371°—310°=61°. That is, to take the case of the horse-power, steam of 371° temperature is passed through a port having a temperature of only 310°, and after being reduced to a temperature of 310° is exhausted through a port having a temperature of 371°. The loss of pressure encountered by passing the hot steam through a cool port, and the back pressure obtained by passing the cool steam through a hot port, must occasion serious loss, and the present large proportion of port areas which are found necessary, especially in fast running engines, are probably due, in a great measure, to the condensation on entering, and the re-evaporation on leaving the cylinder, causing a loss of head or imposing a resistance which is not really due to want of port area, and would not exist were the temperature of the port the same as that of the passing steam.

The well-known high efficiency of the Corliss type of engine is probably not so much due to careful jacketing and the facility for obtaining a correct distribution as to the separate steam and exhaust ports adopted. In suggesting the adoption of separate steam and exhaust ports for marine engines, the author is aware that the complication involved would present the most important feature for discussion, but although no great economy has ever been gained without incurring extra first cost, it is probable that this first cost woud be much less than appears at first sight. For instance the recognized gain of the triple over the two-cylinder compound is about 25 per cent.; it would, therefore, only be necessary to effect this saving in the two-cylinder engine to enable us to dispense with the third engine completely. This saving is probably almost within the scope of the separate valves, combined with efficient steam jacketing. The steam valves, link motion, and reversing gear would be at least 25 per cent. lighter, and it would not be a matter of great difficulty, especially in engines with valve gear of the Joy type, to work an exhaust valve on the opposite side of the cylinder by a simple connection with the connecting-rod. Objection may be taken to the increased clearances involved by separate steam and exhaust passages, but besides the fact that clearance in multiple-expansion engines is not of such moment as in the simple engine, it must be remembered that for the reasons given above—viz., that the condensation causes loss of head and re-evaporation imposes a resistance in the ports—the proportion of port area, and consequently the clearances, could be considerably decreased, while at the same time the independent exhaust valve would give a facility for a correct regulation of the compression. There is another point in which the adoption of separate valves would be productive of direct advantage. In our present piston valves there is a constant leakage in each valve from steam to exhaust side to an extent proportionate to the size of the valve, which is at least one third larger than that necessary for steam alone. In addition to this there is the constant loss by conduction through the thin body of the valve from steam to exhaust side. The steam and heat thus passed, as regards the first two or three cylinders, are only partial losses, although probably serious enough in extent, but as regards the l. p. cylinder they are completely lost.

When we consider the losses by radiation, condensation, and re-evaporation, involving loss of head and resistance in ports and also leakage of valves, it appears likely that by the adoption of separate steam and exhaust valves an improvement may be looked for which might in some cases lead to the substitution of a two-cylinder compound for a triple, and at least postpone the further advance in complication involved in quadruples.

The author regrets leaving the subject without being able to offer more than a suggestion in the way of a practical solution, as, pending experiments, it is at present rather a subject of speculation. What we do know, however, is that condensation and re-evaporation exist to a serious extent; that the

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* Paper by Mr. E. C. Peck, read before the Institution of Engineers and Shipbuilders in Scotland.

initial condensation and what may be called the *initial* re-evaporation bear a very large proportion of the loss, therefore that the cause should be looked for rather in the passages than in the cylinder itself; and that the valves at present used are unsuitable as a device for dealing with steam of varying temperatures.

It is evident that, just as the isolation of the different stages of the expansion of a given volume of steam has been productive of gain in the different forms of the compound engine, a further gain of considerable importance could be obtained by isolating those parts of each engine which have essentially to do with the extremes of temperature.

HIGH-SPEED ENGINES FOR CARGO BOATS.[*]

Weight economy is of great importance in all machinery designed for ships; at the same time fuel economy is of equal, if not greater importance even, when the matter is studied solely from the standpoint of weight required for propelling the ship. To make this evident, take the case of two engines indicating 800 h.p. One engine weighs 90 tons, and the coal consumption is 15 tons per day. The other engine weighs 100 tons, and the coal consumption is 13 tons per day, the boilers being supposed equal in weight and efficiency in each case. It is quite evident that for a voyage of five days the total weight of machinery and fuel will be the same in both cases, and the more economical, although heavier, engine would be preferred by most ship-owners. This comparison would be still more favorable for the heavier engine upon longer voyages, and might even modify the design of engine for other than cargo steamers.

Fuel economy plays an important part in the considerations which should influence the design of engines for cargo boats. There is another point, which, from its importance, might claim the first place, viz.: The efficiency of the propeller. This is undoubtedly of the highest importance, as the engines only exist to drive it, and the real measure of the efficiency of the propelling machinery of a ship is not the coal per indicated horse-power per hour, but the coal per horse-power per hour usefully exerted at the propeller.

The efficiency of a propeller is affected by many circumstances, but only one enters into the scope of this paper—that of variation in the number of revolutions. A slight variation above or below the proper number of revolutions has little effect upon the efficiency, and for this reason it is quite admissible to run the propeller slightly faster than the proper speed, in order to reduce the size and weight of the engines. If, however, the revolutions are considerably above the number corresponding to the maximum efficiency, there is a very considerable loss. Thus, an increase of 50 per cent. means a decrease of about 17 per cent. in the efficiency of the propeller; or, in other words, to give the propelling effect attained at maximum efficiency with 800 h.p. will require at the reduced efficiency about 960 h.p. It would require a marked increase in weight economy to justify this. It will be seen, therefore, that it is not justifiable under ordinary conditions to increase the revolutions of a screw propeller 50 per cent. above the number corresponding to the maximum efficiency. The author is of the opinion that the propeller now adopted for cargo boats of about 800 i.h.p. and 9 to 9½ knots average speed at sea is a very near approach to the best possible propeller for the work. It is the result of numberless trials, and embodies the best practice of each maker. The problem has been worked out by each maker for himself, and the fact that all have reached approximately the same result must be taken as a proof that that result is not far from a correct one.

As this paper is throughout a comparative one, it will be well at this point to place before you the exact type of ship and engines which was in the author's mind when writing it.

The particulars are as follows:

Length on load line...........	281 ft. 8 in.
Breadth, extreme............	36 ft. 6 in.
Depth moulded amidships.....	26 ft. 6 in.
Mean draught from top of keel.	21 ft. 4 in.
Displacement..................	4,766 tons.
Prismatic co-efficient..........	.802
Engines—Cylinders, diameter..	22 in., 37½ in., 60 in.
Stroke	39.
Average speed at sea..........	9½ knots.
" i.h.p at sea....	800.
Average revolutions...........	65 per minute.
Weight of engines with water..	About 105 tons.

This is undoubtedly an economical cargo boat, and the propelling machinery is over rather than under the average efficiency. At 65 revolutions per minute, it is the author's opinion that the propeller is making rather more than the proper number of revolutions for maximum efficiency for 800 i.h.p. and 9.5 knots. However this may be, it is certain that to increase the revolutions 50 per cent. would be to impair the efficiency very materially. It will be seen, therefore, that the propeller is an effectual bar to the adoption of high-speed engines in cargo boats, unless some means is adopted whereby the engines may be run at any desired speed, while the screw shaft still revolves at the speed best suited for the propeller. Gearing is undoubtedly the solution of the difficulty. At the first glance we seem thus to be making a backward step, as it is within the remembrance of many when all large screw engines were geared engines It is not, however, a step backward, but a step forward that the author would advise. Gearing was originally adopted because engineers did not see their way to run the engines fast enough to suit the propeller. Afterwards it was found possible, and, indeed, profitable, to run the engines somewhat faster and to couple them direct to the propeller. The next step undoubtedly is to gear the engines, so that while the propeller runs slowly, comparatively speaking, and at the number of revolutions suited to it, the engines may run faster and at the revolutions considered by the designer best suited to them.

This suggestion is not, by any means, original. It has probably been often made before. The point is this: If it is necessary or advisable to adopt high-speed engines in cargo boats, the only economical way is by some arrangement of gearing. As fuel economy has been shown to have very great bearing upon any question regarding engines for cargo boats, it will be advisable at this point to enumerate some of the points regarding the steam economy of engines which may be affected by the alterations advocated in this paper.

1. In similarly proportioned and similarly situated cylinders, the largest cylinder is the most economical, as the surface of metal exposed to the action of the steam is there least in comparison to the volume of steam in the cylinder.

2. To attain maximum economy, the surfaces exposed to the maximum range of temperature should be reduced as much as possible, due consideration being at the same time given to the fact that the total surface must not thereby be increased unduly. Thus long strokes are beneficial, as they permit of smaller surfaces of piston and cylinder cover for the same work done. At the same time, if the cylinder be made too small in diameter and of great length, the surface exposed to steam may be so increased as to nullify any advantage gained by the small ends. Short, direct parts with a maximum capacity within a given surface are an unmixed good.

3. Other things being equal, that engine will be most economical which has its surfaces, part for part, exposed to the least variation in temperature.

4. Water formed within the cylinder or carried into it by the steam should be got rid of as water, and not re-evaporated in the cylinder.

5. There is a condenser temperature pressure, which will give maximum steam economy.

To make this clear, Table A herewith has been prepared. Table A shows the work which may be obtained from one cubic foot of steam at 175 lbs. per square inch absolute pressure under various conditions of expansion and condenser pressure. It also shows the number of foot pounds per thermal unit obtained under those conditions.

TABLE A.

To Show the Effect of Variation in the Condenser Pressure.

The Figures Refer to the Work Obtainable from One Cubic Foot of Steam at 175 lbs. Absolute Pressure.

(a) Ratios of Expansion.	(b) Total Work Without Loss or Back Pressure in Foot Pounds. PV= Constant.	(c) Net Work Obtainable No Back Pressure, in Foot Pounds.	Condenser Pressure, .085 lb. per Square Inch. Back Pressure in Cylinder, 1.585 lb. per Square Inch.		Condenser Pressure, .5 lbs. per Square Inch. Back Pressure in Cylinder, 2 lbs. per Square Inch.		Condenser Pressure, 1 lb. per Square Inch. Back Pressure in Cylinder, 2.5 lbs. per Square Inch.		Condenser Pressure, 1.5 lbs. per Square Inch. Back Pressure in Cylinder, 3 lbs. per Square Inch.		Condenser Pressure, 2 lbs. per Square Inch. Back Pressure in Cylinder, 2.5 lbs. per Square Inch.	
			(d) Net Work in Foot Pounds.	(e) Foot Pounds Obtained per Thermal Unit.	(f) Net Work in Foot Pounds.	(g) Foot Pounds Obtained per Thermal Unit.	(h) Net Work in Foot Pounds.	(k) Foot Pounds Obtained per Thermal Unit.	(l) Net Work in Foot Pounds.	(m) Foot Pounds Obtained per Thermal Unit.	(n) Net Work in Foot Pounds.	(o) Foot Pounds Obtained per Thermal Unit.
10	83,226	62,419	60,137	129.0	59,539	132.9	58,819	133.9	58,099	133.9	57,379	133.5
11	85,672	64,220	61,710	132.3	61,052	136.2	60,260	137.2	59,468	137.1	58,676	136.5
12	87,819	65,864	63,126	135.4	62,408	139.3	61,544	140.1	60,680	139.9	59,816	139.2
13	89,838	67,378	64,412	138.1	63,634	142.0	62,698	142.7	61,762	142.4	60,826	141.5
14	91,705	68,779	65,585	140.7	64,747	144.5	63,739	145.1	62,731	144.6	61,723	143.6
15	93,444	70,083	66,661	143.0	65,763	146.8	64,683	147.3	63,603	146.6	62,523	145.5
16	95,070	71,302	67,652	145.1	66,694	149.4	65,542	149.2	64,390	148.4	63,238	147.1
17	96,597	72,448	68,570	147.1	67,552	150.8	66,328	151.0	65,104	150.1	63,880	148.6

From the table it is evident that there is a certain condenser temperature corresponding to maximum economy for each ratio of expansion. It is also evident that this temperature is not the lowest attainable, as is usually supposed by scientific men, nor is it that corresponding to a back pressure of about 3 lbs. per square inch, as is usually supposed by sea-going engineers.

This is a matter of some importance, as the efficiency of a steam engine is usually supposed to be indicated by the formula $\frac{T-t}{T}$, which would indicate that the lower the temperature t is made, the greater would be the efficiency of the engine. Of course this does not indicate any fallacy in the laws of thermo-dynamics, but merely a wrong application of these laws. It is the first time, as far as the author is aware, that attention has been drawn to this fact.

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[*] Paper by E. Hall Brown, M.I.M.E., read before the North-east Coast Institution of Engineers and Shipbuilders.

PROTECTION OF CHIMNEY SHAFTS FROM LIGHTNING.—No. 1.

It is by no means uncommon to see tall chimneys unprovided with lightning conductors. On the other hand, many chimney shafts are so provided; but if examined it would be found that their conductors are not efficient. So long as the rod is visible and in place, it is taken for granted that it is ready to perform its function; its efficiency is assumed to be as good as when it was first fixed, perhaps twenty years ago. Corrosion, however, may have destroyed the joints, and even severed the conductor; while the upper terminals may have entirely perished under the action of the gases and weather. So, too, at the lower extremity there may be no proper earth connection.

A tall chimney is more liable to be struck than any other structure—excepting, perhaps, a church spire—and such an accident may be attended with disastrous results to life when the shaft is in proximity to a factory full of workpeople. This contingency alone should be sufficient to call for the compulsory provision of lightning conductors.

The object of a lightning conductor is to facilitate the safe discharge of the spark from the clouds should it occur; but it has another equally important function, its action being preventative as well as curative: It tends to prevent the occurrence of a disruptive discharge by silently neutralizing the conditions which determine such discharges. Such being the case, a lightning conductor should be so constructed as to have that end in view as well as that of safely conducting the discharge to earth; and both these results are obtained by the same means—viz., by increasing the number of terminal points—thus reducing the tension and enlarging the zone of protection. Nevertheless, experience shows that the occurrence of a flash cannot be prevented by the silent discharge of very numerous terminal points. Such cases are attributed to the electrical energy stored up in the clouds being so great that no points are sufficient for the work of silently reducing the tension below the sparking point. Or, again, the electrical energy may be so rapidly generated or sparked from cloud to cloud that there is not time for the choice of the best path, and the nearest object is struck with apparently little discrimination. But under ordinary conditions of electrical disturbance, a path is created inductively beforehand; and a well-made lightning rod, if near that path, will become part of it, thus protecting the building to which it is attached. As a matter of fact it has been found in the course of many years' experience, both in Europe and America, as also in all parts of the world, that lightning conductors seldom fail to act. The past experience of the postal telegraphs clearly points to the practical value of conductors. In the Navy no accident is stated to have occurred since 1872, while the rods attached to British lighthouses have failed on very few occasions only.

The following is a description of a good form of conductor for chimney shafts. Starting with the sky end, points offer the best protection, but they need not be high spikes or tridents. The Lightning Rod Conference of 1881 expressed the opinion that a coronal or heavy band, with copper points about 1 ft. in height at intervals of 2 ft. throughout the circumference, would form the most useful and durable sky end for a conductor, and this advice has since been followed in many cases. Under no circumstance should one point only be carried high up above the shaft, as till comparatively lately used to be the universal practice in England; for one guiding principle is to avoid attracting the lightning—to "let the lightning come to you but not to go to meet it." Several points are better than one, not only because the electric tension (by the influence of silent discharge) is thus more reduced, but because single points are occasionally fused or blunted by a flash, and this injury may remain for a while unnoticed. Copper points should be so platinized, gilded, or nickel-plated as to resist oxidation. On account of this fusion or blunting of points, the Lightning Rod Conference advised the use of a sky terminal, consisting of a stout copper rod having a short point (height equal to one-half of the diameter) to receive the flash without risk of melting the metal, and having at the same time, at 1 ft. below the extreme top, a copper ring bearing three or four copper needles, each 6 in. long, and tapering from ¼ in. to as fine a point as possible, thus separating the double functions of a terminal point. Dr. Lodge suggested the use of cones of copper not too sharp, and gilded or otherwise protected against corrosion.

With regard to the choice for the form or section of the main conductor, of the various styles in use—rope, rod, ribbon, tube, plait, and tape—that most approved of by the Lightning Rod Conference is the copper tape. It is neat, easily fixed, flexible, and free from joints; while this section is considered to offer less resistance to the passage of electricity than any other. It should be about ¾ in. by ⅛ in. thick, and weigh 6 oz. per foot run. The junction with the upper band or coronal can be easily made by clamping and riveting the two surfaces together and embedding the whole mass in solder.

(To be continued.)

CHEMICAL ACTION.

Chemical force is the force which binds together the atoms and molecules of different elements in compound bodies. It is one of the mightiest of nature's powers, and its manifestations are found everywhere and in almost everything. Wherever we find matter consisting of two or more elements bound together to form a substance with essentially different properties, there chemical force is manifested. The difference between a mechanical mixture and a chemical compound is well illustrated by gunpowder. In the manufacture of gunpowder, great care is taken to mix the ingredients together as intimately as possible. The saltpeter, charcoal, and sulphur are ground up together into a paste with water until the mass is perfectly homogeneous, that is to say until every little grain of the compound contains a bit of saltpeter, a bit of charcoal, and a bit of sulphur in the same proportions as make up the whole mass. And yet the microscope would reveal the separate ingredients in gunpowder as in other mechanical mixtures, for the mixture does not descend to the ultimate atoms—it is not a chemical mixture. Applying a match to the gunpowder adds nothing that was not there before, but it excites the chemical force into action. The gunpowder explodes; in other words the ingredients which were mixed mechanically before the match was applied, are now mixed chemically. What, then, does the explosion of gunpowder mean? In the first place it means that saltpeter, charcoal and sulphur when chemically united, form gases which occupy, or tend to occupy, a volume many times greater than the solid materials from which they arise. In the second place, the explosion means, that as a result of the chemical union of these materials, great heat is evolved, which further tends to expand the gases already formed.

All forms of combustion are manifestations of chemical force, and are the most striking we can witness, but at the same time there are many manifestations of chemical force which do not exhibit what would generally be called combustion. The heat of an oil lamp is a direct result of chemical combination, and when oil paint dries in the air the same chemical combination is going on as in an oil lamp burning; but at so slow a rate that the heat is not perceptible. Spontaneous combustion, as it is called, is the outcome of the accumulation of heat due to the slow oxydization (burning) of substances which under more favorable conditions will burn with vigor. Old cotton waste saturated with oil is in a condition precisely similar to the cotton wick of a lamp. It will not take fire of itself, as a rule, any more than a lamp will light itself, but if a heap of old greasy cotton waste is left undisturbed in a confined place for some time there is great danger of its bursting into flame spontaneously.

Oxygen in the atmosphere is in a free state; it is not chemically combined with the nitrogen, but oxygen in water is in chemical combination with the hydrogen. Very few elements can resist entering into combination with oxygen when exposed to its influence, even when at ordinary temperatures; and the affinity of oxygen for most elements when heated is very violent.

Metals which merely tarnish or rust slowly away when exposed to the air, cold, burn like rockets when heated and plunged into oxygen gas, and even in the atmosphere iron at a heat will throw out sparks. Iron rusts quicker when kept moist, because (it is said) the air dissolved in the water is then brought into closer contact with the metal. At any rate iron has no power when cold to extract the oxygen from water. In proof of this let a piece of iron wire, polished up with emery, be immersed in water from which the air has been expelled by boiling, and it will be found to keep clean and bright for any length of time, so long as no air is admitted to the water. Red hot iron and white hot coke, on the contrary, have the power of decomposing water (steam), due to their intense affinity for oxygen when heated. Hence, if steam is made to pass through a coke furnace, say from top to bottom, although steam enters at the top, it is hydrogen gas which comes out at the bottom, mixed with the products of combustion of the coke (compounds of carbon and oxygen). Upon separating these latter from the former, the "water gas" of the Water Gas Company is obtained. In applying chemistry to the steam engine, we find that the chemical force is at once the source of its power, and the enemy of its preservation. We must have heat before we can get steam, and we can only get heat conveniently from chemical action.

Looking at the substances found in the earth, sea, and air of our planet, it is a significant fact that few, indeed, are free to enter into chemical union with each other, and thus develop heat in sufficient quantity to be useful as a source of power. All the more potent combinations are already formed. Oxygen and hydrogen are already combined in the waters of the ocean. The metals are found almost always in combination with oxygen, or sulphur in their ores. Limestones, sandstones, chalk, granite, slate are the outcome after the chemical force has done its work. There remains, certainly, free oxygen in the atmosphere, and of minerals there are one or two which have considerable affinity for oxygen, but these, in the form of coal and mineral oil, we are fast using up for our daily increasing supply of necessary energy. When these fail, a new source of power may possibly be discovered.

Electricity is already, to some extent, a rival of steam, but a supply of electricity can at present only be maintained, either by means of mechanical energy (the dynamo), or by chemical action (primary batteries). The first is merely working in a circle; so that, with the failure of our present source of mechanical energy, our principle means of producing electricity comes also to an end. The thing that is wanted is a new natural source of energy—whether thermal, chemical, or electrical, it matters not, so long as it does not depend, directly or indirectly (as all our present steam engines, hot air engines, gas engines, and electrical engines do in one form or another), upon the chemical affinity of coal and natural hydro-carbon for the oxygen of the atmosphere.—*A. N. Somerscales.*

One of the most singular freaks of human nature is that men should invent steam apparatus when they do not know the first principles of its action.

TRADE NOTES.

DIXON'S Belt Dressing is a very reliable article for the purpose and should be used in all shops. It greatly increases the life of the belt and enables it to do much more work than it would without it. It is thoroughly reliable and is made by the Dixon Crucible Co., Jersey City, N. J.

⁂

RATS have been accused of disposing of large cheeses but that they should make way with a 170-ton barge seems incredible, but when Capt. William Bonnah went to Algonac, where he laid up the '*Harriet Ross*' last fall, he found the marsh rats had made such havoc with her hull that he cut down the spars to save the rigging and abandoned her to the industrious little despoilers.—*Marine Review.*

⁂

ABEL C. JEFFERYS, probably the oldest journeyman machinist in this country, died in Carrolton, Pa., Tuesday, aged 90 years. He worked on the building of the famous first American-built locomotive, '*The Best Friend of Charleston*,' which was made at the West Point Foundry, in this city, in 1831, under the direction of the late Horatio Allen. The deceased worked at his trade for 75 years, having been apprenticed at the age of 14, and only retired from active work one year ago.

⁂

JAS. I. KENDALL, of Detroit, has excellent success with his piston packing, "The Kendall," this season. The pistons of the following steamers have been fitted with it this spring: '*Merrimack*,' '*Massachusetts*,' '*R. P. Flower*,' '*F. L. Vance*,' '*Pickands*,' '*Livingstone*,' '*T. W. Palmer*' and the '*Maryland*,' now building by Detroit Dry Dock Co. D. C. Whitney's new steamer will have a 54″ low pressure and 32″ intermediate, engines being built by the Frontier Iron and Brass Works, of Detroit.

⁂

JEROME NICOLL, who had been at work for over fifty years trying to solve the problem of perpetual motion by inventing a machine that would work on that principle, died at Baily's Station, Pa., on Tuesday, aged 81 years. He was an Alsatian, and in the early days of lumbering in the Allegheny Valley made a large fortune by buying and selling pine lands. He spent a large fortune on his experiments, but years ago he paid for his coffin and his undertaker's bill, so that he would be sure of respectable burial.

⁂

BENJAMIN F. STURTEVANT, of Boston, the well-known inventor, died of apoplexy on the 17th inst. He invented the first pegging machine and also the first machine for cutting continuous strips of wood veneers from logs. Among his minor inventions were the first machine to manufacture wooden toothpicks and a projectile which was used by the Government in the late Civil War by the swamp angel before Charleston. In 1864 Mr. Sturtevant invented the blowers and exhausting fans which bear his name.

⁂

THE Rice & Griffin Manufacturing Company of Worcester, which is run on the profit-sharing basis, divided a surplus of $2,755 among eighty-one employees last week, all of whom had been with them at least six months. Those were the earnings of 1889. The plan, which was begun in 1887, provides that after deducting 6 per cent. of the capital invested, the balance of the earnings shall be divided proportionately between the capital and the total yearly pay roll, each employee to share according to the amount of wages he has received during the year. The time of service required in order to participate in future profits has been extended to eight months in the year, which benefits and tends to increase the number of permanent workmen. The share of those who received a part of last year's earnings is equal to about 6½ per cent. on their wages, or more than three weeks' pay to those employed by the company all the year.

⁂

ASBESTOS mining is carried on by cutting down the hills of asbestos-bearing serpentine, much as a farmer cuts down a stack of hay, or by open quarrying on the level. The rock is blasted out and the asbestos separated by hammering from foreign matter. This is a comparatively easy matter in the case of the finer quality, as it usually separates readily from the gangue, but, in the lower grades much difficulty is experienced in separating the fibrous matter from the non-fibrous. At best there is a great waste. Much of the asbestos is in thin and narrow veins, and is wasted, as, by the present mode of operating, it does not pay to separate this from the serpentine. A machine that will enable these narrow veins to be utilized is needed when "cobbed," asbestos is graded according to purity, color and length of fiber, into three grades. The finest quality, or "firsts," finds ready sales at prices ranging from $80 to $100 per ton; "seconds" fetch from $50 to $70 per ton; while "thirds" may be valued at $13 to $15 per ton.

⁂

A. MALLET says in the London *Engineer* that it appears to be not much known that a Dutch engineer, Roentgen, took an English patent for the compound engine, under the name of his representative in England, A. D. 1834, 6600, Ernst Wolff, "Improvements in Steam Engines." Under this modest title, it contains an exhaustive description of what we name to-day the compound engine, and leaves nearly nothing to be patented by subsequent inventors. In the plate is figured a compounded side lever marine engine. That plate was reproduced in the *Bulletin de la Societe des Ingenieurs Civils* in 1873. The French patent was secured under the name of MM. Andre Kochlin et Cie., of Mulhouse, February 22, 1834, for a "Machine Expansive à Cylindres Independants et Combines," and a pair of compound beam engines, according to the Roentgen's design, was built by the above said well-known firm for a spinning mill in Vieux-Thann. Particulars of that engine are to be found in the *Bulletin de la Societe Industriele de Mulhouse*, vol. ix., 1835, and also in the *Lecons de Mecanixqe Appliques*, by A. Morin, vol. iii., p. 167, 1846.

⁂

GENERAL passenger agent, C. G. Hancock, of the Philadelphia and Reading says that a remarkable feat in railroading was accomplished a few days ago on the New York division of the Philadelphia and Reading Railroad, when a special passenger train covered the distance of 90 miles between Philadelphia and New York in the short time of 85 minutes. The engine was "No. 366," of the type originated by the Reading Railroad and was built for the regular fast passenger service. No special preparation was made for a fast run, both engine and crew being selected hastily and almost at random to meet a sudden call for a "special." The first revolution of the drivers was made at 11.38 A. M., and the real running began at Wayne Junction. From this point the road is peculiarly adapted to the attainment of high speed, being straight, free from heavy grades, and in excellent condition. The 54 9-10 miles between Wayne Junction and Bound Brook were covered in 49½ minutes, an average speed of 66½ miles per hour. The highest rate of speed reached was 87 miles per hour and stretches of several miles were run at the rate of 81, 82 and 84 miles respectively.

⁂

E. E. ROBERTS recently shipped from the Works at Red Bank, N. J., two 500 h. p. water-tube boilers for the '*Tillie*;' also one 150 h. p. boiler for Mr. Snellenburg's new yacht. The four 200 h. p. boilers for the '*Radha*' will also soon be in the boat. All these boilers are water-tube and have been tested, under hydrostatic pressure and 200 lbs. live steam before shipping. There are also under construction and nearly ready for shipment: One 300 h. p. boiler for Congressman McMillan's yacht '*Idler*,' of Detroit; one 400 h. p. boiler for Dr. Pierce's new yacht, now nearly finished, by Wintringham; one 200 h. p. boiler for Mr. J. Frederic Tams' side-wheel yacht, building at Piepgras' yard, City Island; one 175 h. p. boiler for Mr. J. D. Rockefeller's new yacht now being built by the Gas Engine & Power Company; one 300 h. p. boiler for the yacht '*Hinda*,' belonging to Mr. Allan M. Fletcher, of Alpena, Mich.; one 150 h. p. boiler for Mr. Francis Boyd, of Milwaukee, Wis., and some twenty or thirty other boilers of smaller sizes for various purposes. E. E. Roberts has been shipping during the winter an average of about two boilers per week, and is now about twenty-two boilers behind orders, including boilers for the Pennsylvania Railroad Company, and the United States Lighthouse Board. Mr. Roberts is making plans for an addition to his works to cover about 45 ft. × 200 ft., and hopes next season to be able to accept all the orders that may be offered. His handsome new illustrated circular has proved a great success, as it gives much valuable information.

⁂

CARROLL D. WRIGHT, the Commissioner of Labor, has submitted to the President his fifth annual report. It shows that on June 30, 1889, the whole number of R. R. corporations in the United States was, approximately, 1,718, and the mileage, approximately, 156,400 miles. The number of employees on all of the railroads of the country on that date was 689,912. The purpose of the Commissioner's investigation was to ascertain the relations of railway employees and the corporations; the wages paid in different parts of the country and the time lost. Upon investigating the subject extended to about 600 corporations, by which the real railroad business of the country is performed, it was found that 377 prohibit the use of liquor. As a whole it is found that railroad corporations of this country do not, to any great extent, maintain beneficiary institutions of their own or assist outside institutions. A fair share of the roads assist their employees in securing life or accident insurance. A very large number of roads provide some system of technical education for the men in their shops, and a few roads have technical schools for their employees, and in some cases for their families. The wages side of railroad labor is given very fully in the report. The whole number of specified titles of occupations of the sixty roads investigated is 1,117, classified into seventeen occupations. The report shows the facts outlined for 241,910 employees. The average daily rate of employees paid by specific time on the sixty roads is $1.64. It is also shown that of the whole number of employees 101,905 earn less than $100 per year; 33,621 earn from $101 to $200 per year, and 21,517 earn from $201 to $300 per year. The average earnings on all the sixty roads per year is $243, although less than 60 per cent. of all earn less than this average. The report shows the average daily rate of pay in each of the seven groups of seventeen occupations. Baggagemasters, for instance, employed in group one, receive on an average $1.78 per day; in group two, $1.58 per day; group three, $1.32; group four, $1.46; group five, $1.10; group six, $1.79; group seven, $2; average, $1.63. The brakemen in the same groups receive $1.80 in the first, $1.73 in the second, $1.26 in the third, $1.86 in the fourth, $1.95 in the fifth, $1.75 in the sixth, and $1.96 in the seventh; average, $1.78. The average pay per day of locomotive engineers in each of the seven groups is $3.32 in the first, $3.17 in the second, $2.91 in the third, $3.07 in the fourth, $3.55 in the fifth, and $2.79 in the sixth. No average is given for the seventh. The whole average is $3.22. Conductors show a very steady rate for the whole country, being $2.82 per day in group one, $2.54 in group two, $2.58 in group three, $2.68 in group four, $2.92 in group five, $2.85 in group six, and $3 in group seven. These figures are regarded by the Commissioner as valuable; inasmuch as they are the result of as perfect a classification as can possibly be made from the actual pay rolls of the roads involved. An interesting comparative table is given as to the wages paid railroad men in this country and in Great Britain. The British rates are taken from the official returns of wages paid to railway servants on the principal lines in Great Britain by the Amalgamated Society of Railway Servants of England, Ireland, Scotland and Wales. This table shows that the average daily pay of locomotive engineers in Great Britain is $1.46; in the United States, $3.22. Of firemen in Great Britain, 91 cents, in the United States, $1.79. Conductors in Great Britain, 97 cents, in the United States, $2.63. Switchmen in Great Britain, 85 cents; in the United Statas, $1.50. Flagmen in Great Britain, 81 cents; in the United States, $1.13.

NOW, just as ship builders and mariners have discovered that spars and sails are no good on fast steamers, but rather a hindrance by reason of their weight, the daily paper engineer demands to have them put back, because the '*City of Paris*' disaster shows the ship was helpless without them. Some people ought never to go out of sight of home. They want everything insured to them and no blanks in their lottery.

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IN former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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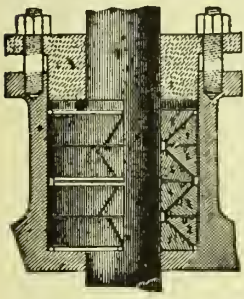

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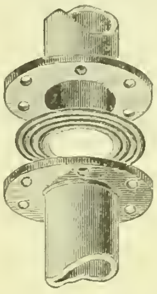

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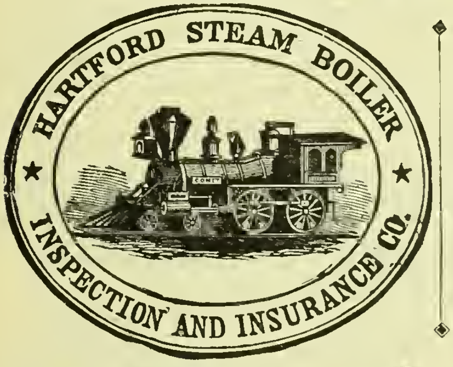

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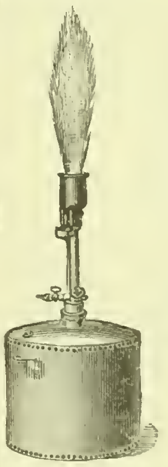

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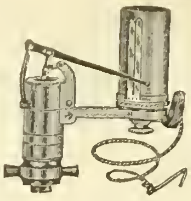

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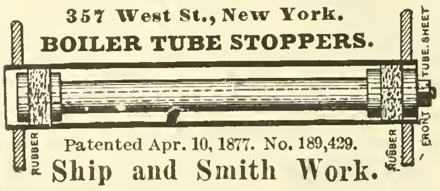

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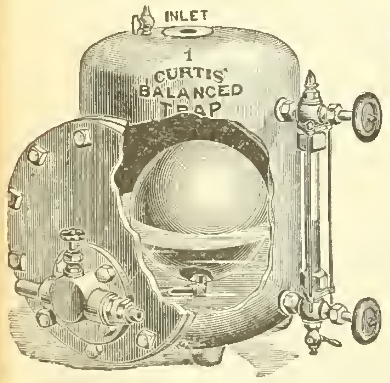

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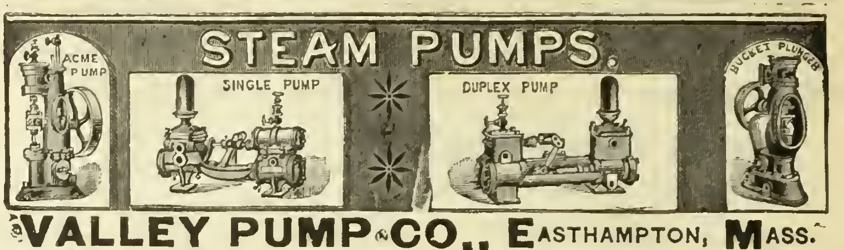

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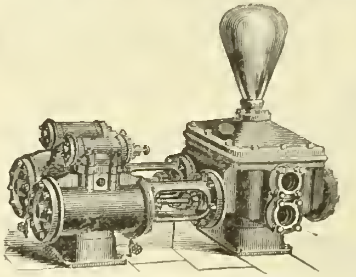

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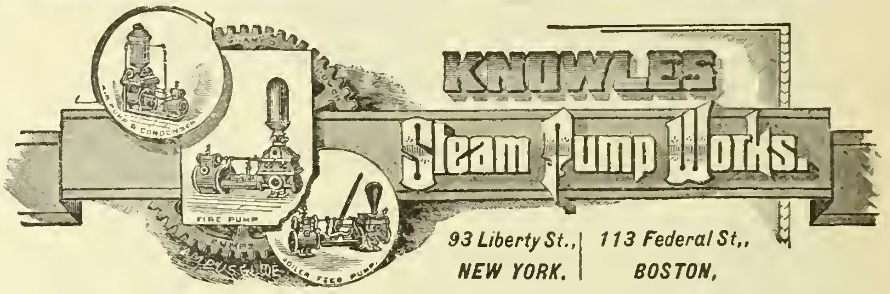

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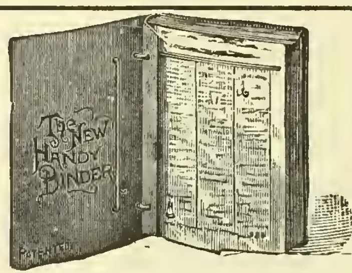

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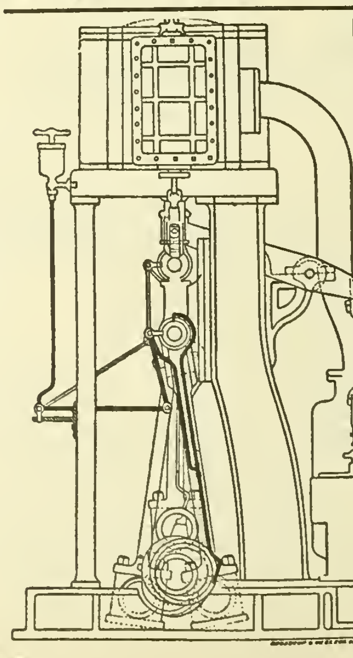

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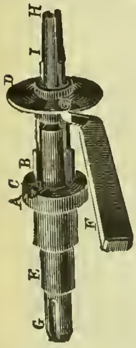

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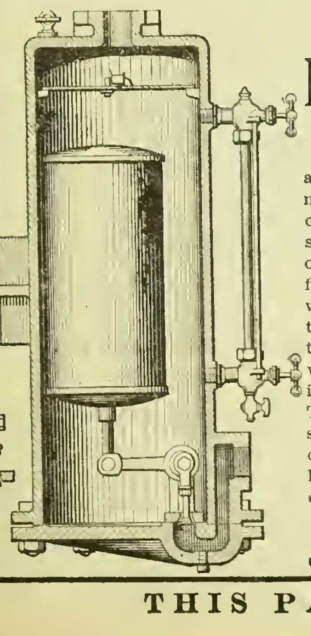

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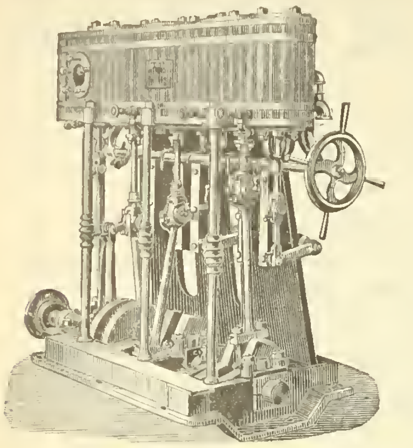

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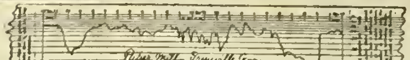

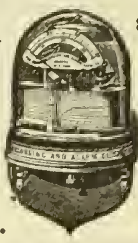

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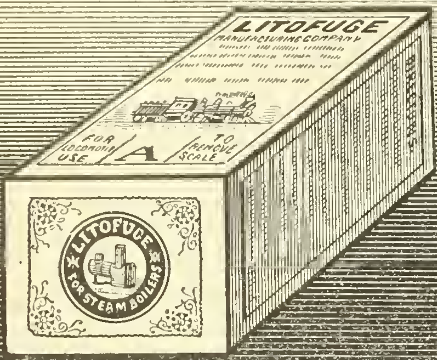

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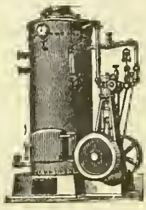

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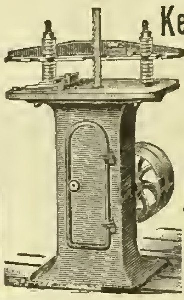

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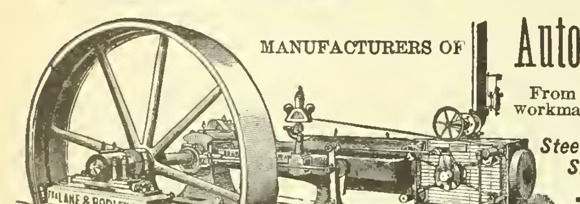
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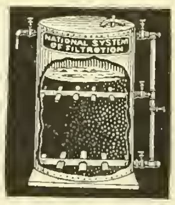

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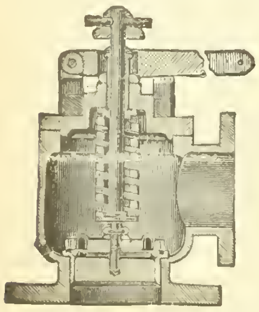

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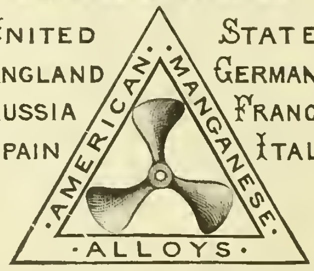

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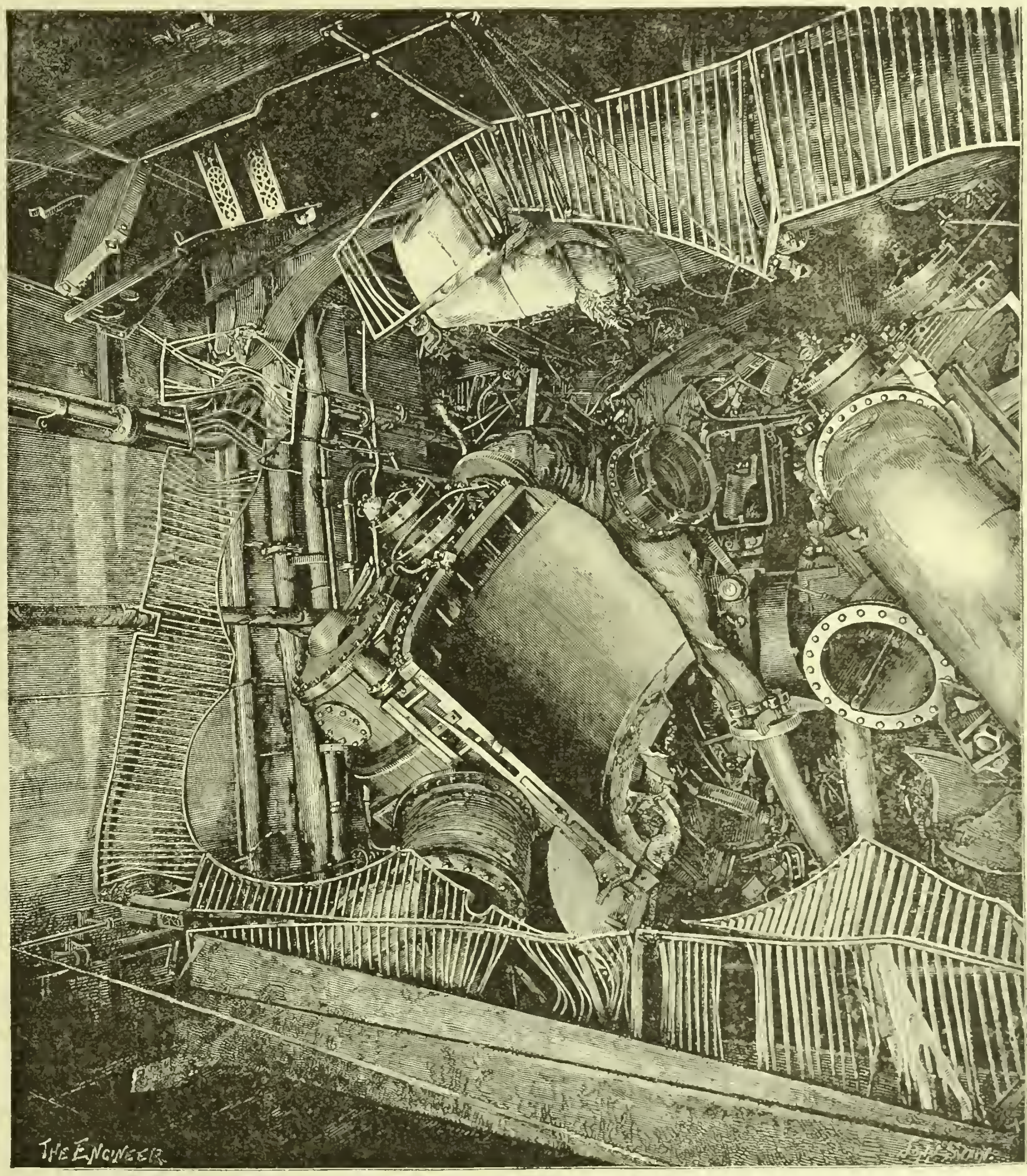
STARBOARD ENGINE-ROOM OF THE 'CITY OF PARIS.'

THE engraving represents the starboard engine-room of the '*City of Paris*' after the accident, from photographs taken by the Inman Company. Not much can be learned from it, but the full details, which are too long for this page, will be found upon page 116.



◆

THE cartridges for a six-inch rifle are composed of grains of powder that looks like iron nuts, one and one-quarter inches thick and an inch in diameter. The grains are piled one upon another in the cartridge bag, leaving a hole in the center of the bag from top to bottom. This hole, which is about an inch in diameter, is to allow the flame to go from the base through the charge, starting the ignition at all points of the cartridge at the same time.

Were not this precaution taken, some of the powder would be blown out of the gun unignited. The grains are built up on forms, a wire running through them and keeping them in place. A bag is then drawn over the grains and the wire removed. The bag is strengthened by a "Hercules braid." If it were not for this braid the weight of the charge would burst the cloth. This bag is enveloped in a copper cylinder which is hermetically sealed. When the cylinder is run up from the magazine to the deck, the lid of the tie end of the bag is removed and the case inserted in the gun; the other end is then pulled off and the short rammer is used to shove the charge home and out of the cylinder. The weight of the cartridge is about fifty pounds. In all, the charge contains some 600 grains of powder.

◆

EXPERIENCE seems to point to gun cotton as the power to be used in manufacturing torpedoes in the future, and the abolishment of nitro-glycerine and dynamite on account of the danger in handling and transporting.

WHERE IS THE GAIN?

IF, as the adage says, "there is no loss without some gain," we are sure the Messrs. Thompson, builders of the '*City of Paris*,' would be glad to know what they are to gain by their losses on that vessel. Their case is a specially hard one. Built upon guarantees that the vessel would make the voyage in a certain specified time, she had not been accepted by the company running her. The last voyage, if it had been successful, would have completed the contract and the ship would have been turned over. It was not successful and the cost of the repairs, $200,000, to say nothing of salvage, and the constructive damages for losses by detention in the very busiest season, will make a bill which will be for a very serious amount. It will be observed that the repairs are not being made by the builders, but by Messrs. Laird, a distinct firm.

◆

THE Manual of Screw Cutting is out of print; do not send for it.

THE SEQUENCE OF EVENTS ON THE 'CITY OF PARIS.'

REFLECTING upon the sequence of events from the known cause of the breakdown on the '*City of Paris*,' it seems to us that they may have occurred in the following order: When the shaft broke the headway of the ship pulled the wheel back in its bearings as far as possible, and the main engines, released from their load, flew around at an immense velocity. This they could easily do, with three cranks, 120° apart. The free end of the broken shaft ran out of truth and fouled, ripping up the binders all the way through, thus releasing the piston enough for it to knock out the low-pressure cylinder head. The piston-rod was then punched through the piston and fell over on top of the low-pressure cylinder, when dragged by the main cranks which were still revolving, it raked right down through the low-pressure cylinder, cutting it in halves and tearing it loose from the legs of the frame, when the immense masses of falling iron completed the destruction. The smashing of the surface condenser seems to indicate that the piston-rod and connecting rod were dragged down through the low-pressure cylinder from top to bottom by the revolving shaft. The breaking of the pillow-block binders must have preceded the release of the piston, in order to raise it enough to knock out the cylinder head. Compressed steam could not have done it, for there is none in the low-pressure cylinder to compress, the cylinder being swept clean by the condenser at every exhaust. In order to destroy the condenser, everything in front of it must first have been broken away.

◆

OF diamonds, ninety-five per cent. of the current supply comes from the Kimberley mines of South Africa. Over nine tons of diamonds, valued, after cutting, at $500,000,000, have been taken from those mines since their discovery in 1867.

LIGHTHOUSES.

The Cape Henlopen light is what is called a fixed white light of the first order. The lamp is on top of a white masonry shaft, and is 128 feet above the tide. The lamp itself is not a very simple device though easily operated. There is a cylindrical bowl for holding the oil, with a capacity of perhaps five gallons. Resting on top of the oil is a piston or plunger. It is raised to the top of the bowl by winding up a winch. Then the bowl is filled with oil and the plunger allowed to press down on it. The weight forces the oil up through a small brass tube and into the wick holders. There are five wicks in circles, one within the other, the outer circle being about four inches in diameter. The air is drawn up through spaces between the wicks around a glass chimney fifteen inches high, serving to promote the draught, while a sheet-iron chimney above the glass and leading out of doors still further aids the draught. The lamp stands on a pedestal in the center of a little six-foot room, the sides of which are glass lenses, so arranged as to capture all the rays of light that radiate from the flame of the lamp and cast them out in planes parallel with the plane of the horizon. Seen within this room the flame is four inches in diameter by five high, but seen from the sea it is a great flame, as large as the lenses themselves.

Outside the lenses there is a cast-iron frame which supports a wall of plain window glass a quarter of an inch thick. On one side of this light there is a broad sheet of red glass about one-eighth of an inch thick. The keepers call it a red cut, and when a vessel has that red cut fair over her stern she is heading up the main channel of Delaware Bay.

To keep this light burning, the services of three men are required. A veteran of over twenty years' experience, D. D. Joseph, has charge. The routine of duty is simple. The night is divided into three watches. A man comes on duty at 2.30 o'clock in the morning. He ordinarily has nothing to do but sit in a chair and keep awake until the almanac says the sun is rising out on the Atlantic. Then he puts out the lamp and begins to clean up. The chimney, the lamp itself, every fraction of an inch of surface about the lenses and the glass outside must be wiped with the utmost care. Linen towels ordinarily serve, but sometimes ammonia and at others a white powder used among shore people for cleaning silverware is applied, for dirt that comes from no one knows where is dashed against that lamp in spite of its height from the ground and sea. After the glass is cleaned and the bowl of the lamp filled the little room itself must be cleaned and dusted. Then the stairway to the room below, where the man on watch sits, must be wiped off, and then the watch room cleaned, and the gallery around outside as well. Below that is the weary stairway from the bottom of the tower, a distance of eighty-five feet, to be cleaned. The deck of a man-of-war and parlor floors are synonymes for cleanliness, but no structure in the world has so much pains taken with it to keep it absolutely clean as a lighthouse, for perfect cleanliness is essential to a perfect light.—*N. Y. Sun.*

◆

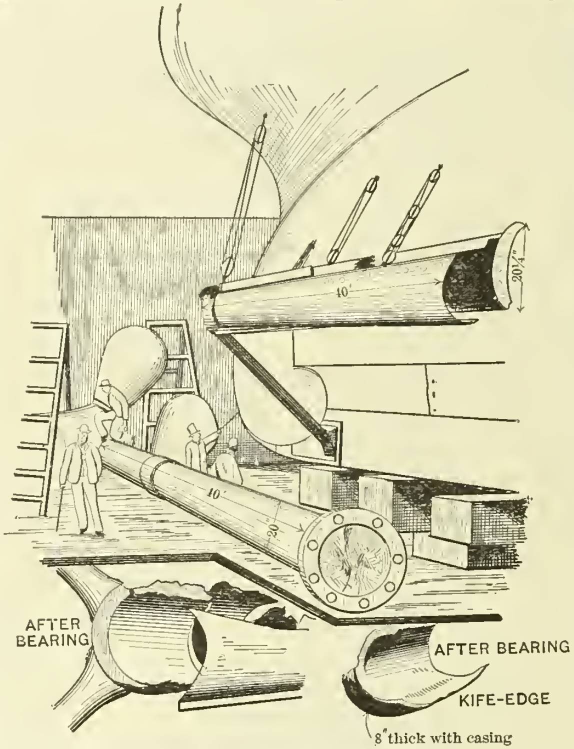
The connection between alligators and crops seems remote, but it is not. Alligator hunting is an industry in Louisiana and Florida, and the monsters are rapidly being exterminated. So marked has been this destruction that the Police Jury of Plaquemines Parish, La., have been compelled to prohibit the further killing. It seems that alligators feed largely on muskrats, and since the lessening of the number of the former the rats have increased enormously, and have seriously damaged crops. The jury prohibits the killing of alligators in the bayous, marshes, canals, or on any portion of the land or body of water under the penalty of $25 fine and imprisonment of not more than one month for each offense.

THE 'CITY OF PARIS' BREAKDOWN.

By an American Engineer.

Upon the last voyage of the '*City of Paris*,' an American engineer, a prominent member of the *Engineers' Club* of this city, was present, and we are able to give his views of the causes which led to the breakdown. This gentleman is a capable observer, and his solution of the matter is undoubtedly a correct one.

"Have just returned from a visit to the '*City of Paris*' in the graving dock at Birkenhead, and, as a marine engineer, believing you will be interested in knowing how it all came about—that so well appointed a ship could become so completely disabled—I will give you, in the language of a brevet engineer, the results of my visit. The starboard shaft ($20\frac{1}{2}$″ diam.) leaves the hull of the vessel through a stern bearing, and for forty feet runs through a sleeve projecting from the hull. At the end of this sleeve there is a bearing (after bearing); this bearing is of cast steel and supported by two brackets, the upper one of the same casting as the bearing itself and bolted to the hull, the lower bracket a separate piece, bolted both to the bearing and to the hull.



"Now this after bearing, which is 6′ long $3\frac{1}{4}$″ thick, has a composition liner $1\frac{1}{4}$″ thick, and lignum vitæ staves placed inside the liner similar in all respects to the staves of a barrel; with only this difference: one of the staves (which I shall call the key stave) was held in place by bolts and nuts. These staves got adrift, the liner wore away; the bearing supported by brackets wore down to a knife edge and there was a play for the shaft inside the bearing of at least eight (8″) inches. This play and the leverage of forty feet did the business thoroughly. The cost of repairs alone will reach $150,000 to $200,000, to say nothing of salvage and loss of reputation to the line. To recapitulate: a shaft 40′ long projecting through a stern bearing, broke short off, like a carrot, inside the stern bearing owing to the lignum vitæ staves fetching away, and the subsequent grinding out completely of both liner and after bearing.

"I have been down in the engine room today and never saw a more complete wreck. There were 16, not 6, struts or shores in boiler room to keep the bulkhead intact, and it was God's mercy alone in keeping down wind and sea, that saved us.

"Since leaving Liverpool, I have procured a copy of the London *Graphic* containing cut of starboard counter of the '*City of Paris*,' showing fractured shaft and after-bearing, worn to a knife-edge, as described above. There seems to be no doubt that the fetching away of the lignum vitæ pieces inside the lining caused the wear of both lining and bearing, and consequent free play of the shaft in the bearing close to the propeller. This "play" was eight inches or more, so that the shaft for forty feet up to the bearing, where it enters the hull of the vessel, hung with its full weight and the weight of the propeller, and wobbled about until it broke the shaft short off inside the hull. The break is shown clearly in the sketch. The metal of the shaft is clear of any flaw. You can readily imagine that, as the starboard engine was working up to 10,000 i.h.p. at the time the shaft broke, no governor could control it quickly enough to prevent the heavily-moving parts of the l. p. engine going to pieces as they did. The piston-rod, tail-rod, connecting-rod and crank-shaft were all connected and intact, but bent, as I saw them to-day. A piece of the 113″ piston was attached to the rod about the size of a felt hat. The balance of the piston was scattered far and wide. It was these rods which punched holes through the longitudinal bulkhead separating the engine-rooms."

◆

Mr. Geo. Quick, Fleet Engineer R. N., writes to the technical press of England as follows: "Will you kindly permit me to call attention to the desirability of having an auxiliary hydraulic propeller or turbine fitted to all large vessels, to act as a last reserve propeller in case of the breakdown of the main engines or screw propellers, and also to act as a very powerful pump in case of collisions, etc? In January, 1876, the late Admiral J. C. Wilson read a paper for me on 'A Proposed New Combination of Propellers,' at the Royal United Service Institution, treating on the centrifugal pump—1st, as a reserve propeller; 2d, as a most powerful bilge pump; 3d, as a most powerful fire engine. Calculations showed that, with a very low efficiency, a centrifugal pump worked by a steam engine of 700 i.h.p. would alone drive H.M.S. '*Devastation*,' of 9,300 tons displacement, at a speed of nearly seven knots per hour, and that it could remove 15,000 tons of water per hour from the ship. And, if only 400 i.h.p. were employed, the speed would be nearly six knots per hour, and the quantity of water that could be pumped out of the ship would be 8,500 tons per hour. In the paper referred to, I suggested that, in lieu of one pair of engines working one centrifugal pump, it may be desirable to use two or more sets of independent engines and pumps of small power, separated from each other by watertight bulkheads. I know all the objections to the use of the hydraulic propeller, and the difficulties in the way of fitting it on board ship, but it appears to me that, with the high-pressure steam and high-speed engines of the present day, the difficulties are very much less than formerly. I need not, I think, point out the advantage of having immense pumping power in combination with a small reserve propelling power in our vessels of war, in case of injury to the hull or to the main engines during action; but I venture to submit that this is a matter which deserves some attention."

◆

Of course the daily paper engineer comes out in force on the '*City of Paris*' accident. This is from the *Herald:*

> "The accident to the great Inman liner is one which might happen to any ocean steamship with equally bad results. When, from any cause, racing of the engines occurs, the engineer must risk his life to cut off the steam supply, and it is not always certain that he will succeed in the attempt. But with governors attached to the engines the security against a dangerous breakdown would be immensely increased."

This is from the *Sun*, and is unnecessarily stupid:

> "It was through the twenty-inch surface condenser tubes, smashed by the swinging around of the connecting-rod, that the water poured and put out the fires."

None of the fires were put out, and the surface condenser tubes are three-fourths of one inch, not 20″.

◆

The Manual of Screw Cutting is out of print; do not send for it.

SHRINKING CRANKS ON SHAFTS.

A WRITER in a foreign paper tells us how to shrink a crank on to a shaft. This way, for instance:

"When the crank has sufficiently expanded, remove it smartly from the fire, and clear the hole from cinders, etc., by means of a wire brush (a piece of waste is not a good thing to use, as portions adhere to the metal and carbonize, remaining in the hole). Have tackle ready to immediately sling the crank upon its bearing, driving it on with a lead or copper hammer, or a sledge driving upon wood blocks, so as not to damage the crank face. As soon as sufficiently driven home drive a key into the keyway, a slack fit top and bottom and a sliding fit sideways, thereby adjusting the crank accurately upon its seat. Try a square upon the crank neck, and the boss to see that the crank is put on square with its shaft. Allow to slowly cool, and fit the keys."

If he has to *drive* the expanded crank on the shaft he will get into a peck of trouble. It will seize at once, and he cannot budge it. The crank should swing into its seat at once. It is of no use trying the crank with a square after it is shrunk on. If it is out of square, it cannot be made true.

◆

ASSUMING that a community of 100,000 workers can produce in a day, by the labor of ten hours, wealth to the value of $300,000, then if their labor is cut down to eight hours a day, they must either work harder or more skillfully in the shorter period, or there will be one-fifth less of wealth to divide among those interested in its production. There is no way of getting over this. At the present time the wages earned are paid, and the capitalist receives his returns from the gross sum of production. If this sum is cut down in any way, a loss is inevitable either on the side of the capitalist or wage earner, or on both sides. While $5 divided among five men will give each $1 apiece, there is no process of arithmetic by which $4 divided among five men will produce the same result.—*Boston Herald.*

◆

"TASTE has advanced in the matter of precious stones as well as in the fine arts. Ten years ago $100,000 was an unusual amount for even the wealthiest family to have invested in diamonds; to-day there are a number of families each owning diamonds to the value of half a million. Earrings worth from $5,000 to $8,000 a pair excite no wonder to-day; formerly they were seldom seen. Of the French crown jewels sold in Paris in 1886, more than one-third, aggregating over $500,000 in value, came to America. Three diamonds are owned in this country weighing 55¼, 77, and 125⅜ carats respectively. The latter, known as the Tiffany diamond, is the handsomest large yellow diamond ever found. A number of necklaces worth over $100,000 each are owned in the United States, and one worth $320,000 was recently sold at the death of its owner."

◆

AND now it is an improved locomotive which is to save $25,000,000 by a down draught. One is being built in Portland, and, of course, the largest capitalists in the country are "backing it." There is nothing novel in the principle employed, as explained by the daily paper engineer. As all inventions depend for success upon the correctness of principles, it is safe to assume that this particular locomotive will not revolutionize the railway traffic of the country right away.

◆

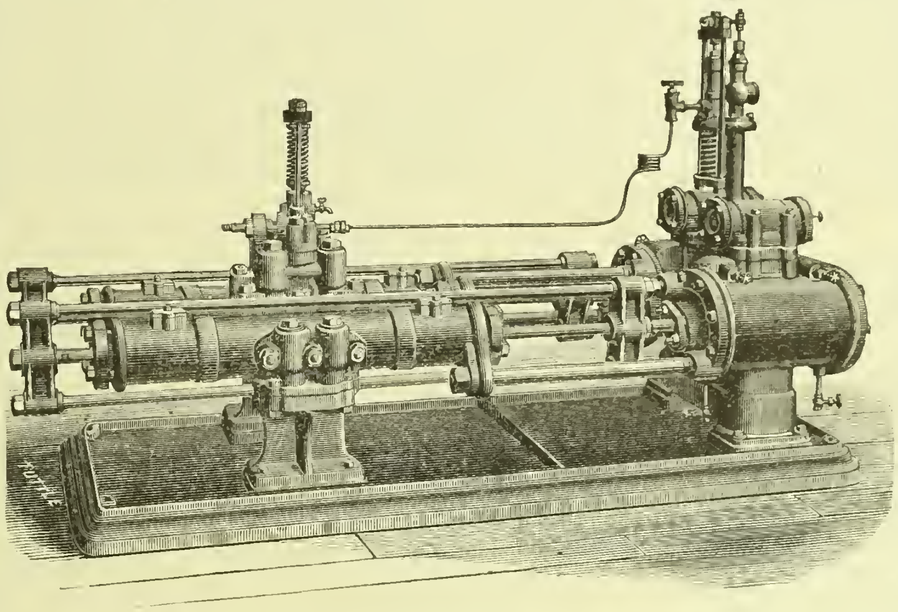
THE first of May was to be a great uprising of trades all over the world. Nothing happened of the least moment, and all the daily papers of this city wasted pages in telling of it.

HALL DUPLEX PRESSURE PUMP.

THE engraving represents a new design for pressure pumps which has recently been brought out by the well-known Hall Steam Pump Company, of New York and Pittsburg, Pa., in which latter place their new shops are situated and now in full working order.

The Hall pumps are so well known that special explanation of their details is unnecessary. They are particularly adapted to office buildings, apartment houses, and steam yachts, from their noiseless action—a feature of great importance in public service.

This particular pump is for high service, or where heavy pressures are needed, as may be seen from the proportions of this machine, which are 10″ steam cylinder, and 1¼ plunger, by 12″ stroke—proportions which give high duty with ordinary steam pressures. It is intended for use on cotton presses and oil mills, also in the manufacture of lead pipes and is fully guaranteed as to its action; as all parts are made to gauge, and interchangeable, repairs and renewals can be promptly made. It is now in use in the South largely where it is greatly liked. Address, Hall Steam Pump Co., New York and Pittsburg, Pa.



◆

IN an article upon the evaporation of boilers, Mr. Michael Longridge concludes with this advice:

1. Get your boilers designed for the work they have to do, and not made 7 ft. 6 in. by 30 ft. or 8 ft. by 28 ft as the case may be, because it is the fashion to have boilers of these particular dimensions.
2. Do not stick to 6 ft. grates if a shorter length is required to burn the coal at the rate of from 16 lb. to 21 lb. per hour.
3. Reduce your draught as much as the nature of the coal and the smoke inspector will permit. Try and reduce it till the fire is hot enough to melt a piece of steel boiler plate.
4. Buy your coal dry and keep it dry. Weigh the ashes which come out of the furnaces as well as the coal that goes into them.
5. Be most careful to stop up air leaks in the brick-work and between the brick-work and the boiler.
6. Establish a gasometer for collecting gases from the flues and analyze them for carbonic acid, and try to get 10 or 11 per cent. of that gas in the samples by cutting down the draught. The apparatus and its manipulation are of the simplest character, and the information gained will be of great practical utility, and will often lead to considerable economy.

◆

THIS is a great age to live in. Immense inventions, wonderful discoveries, unparalleled luxury, and city highways that would disgrace a third-rate backwoods town!—*Boston Herald.*

◆

YOU can flatter the worst idler on earth by telling him he is working too hard.—*Atchison Globe.*

A SEA captain recently took what are probably the most careful observations as to the height of ocean waves in a gale which have ever been recorded. He made them during a voyage round Cape Horn, and to do it he went up to the main rigging, to get, if possible, the top of the wave coming up astern in a line of sight from the mast to the horizon at the back. The reason he selected the mainmast was this: That, as a rule, it is nearly amidships (the actual foot of the wave below the mean draught, equal to the sight elevation), and the observer necessarily is above the true height. It was a difficult operation, but the captain obtained some good observations, marking the height of the waves on the mast. On measuring the distance from these to the mean draught, he found them to be as follows: 61, 64, 58 and 65 feet respectively, varying in length from 650 to 800 feet.—*Notes and Queries.*

Did he take a plumb-bob with him, to see if the ship was on an even keel?

◆

ALL through Germany and Austria I saw women mixing and carrying the mortar for the masons and bricklayers. They do not use hods, but a kind of a tray which they carry on their heads. In Zurich I saw a peculiar style of pile driving. The weight was hauled up by a rope drawn hand over hand by a gang of men, who would let go the rope when they wanted the weight to drop. This method did not work as well as ours. In Munich I visited one of the beer gardens frequented by workmen and talked with an intelligent stone cutter. He said the workmen rarely had meat to eat more than once a week. Their dinner consisted of their beer and a little brown bread and sausage. The beer costs them 2 cents a gallon, and they drank it quietly at work or at dinner. I saw no disorder whatever among them, and, in fact, saw but three drunken men during the whole time I was in Europe.—*George Watson, in Carpentry and Building.*

◆

A GERMAN paper says: "That an old chimney 67 feet high, with an internal diameter of 19.6 to 13.8 inches, and with total passage, from fire to chimney top, of 98 feet, was taken down, and a new chimney with an intended total draught of 95 feet, and a minimum internal diameter 25.5 inches, was planned. When the chimney had gone up 39 feet, it was tried. Already there was a great improvement on the old chimney; at 46 feet, still better, and at 52½ feet the draught was excellent, the smoke issued without soot, and there was an economy of of from 15 to 20 per cent. in fuel. So the chimney was finished off at that height. Herr Ramdohr recommends a uniform internal diameter as being more rational, and as protecting the brickwork from the hot and rapid axial stream. The cross section of a chimney should be from one-fourth to one-eighth of the grate area, and the height not less than 50 feet, should not exceed 100 to 120 feet (the diameter being made to suit), unless the chimney is at a distance, in which case it may be 160 to 200 feet, the diameter being regulated according to the amount of soot which escapes."

Thus do the doctors disagree. What is the use of building chimneys 300 or 400 feet high?

◆

A BILL has been introduced in the House, the provisions of which authorize the Secretary of the Navy to expend $2,000 in testing the "Bender" propeller system.

We should like to know why. The Bender system is no more entitled to be experimented with at the public expense than any other.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

AN AWKWARD QUESTION.

Editors ENGINEER:

Reading the accounts of the disaster to the '*City of Paris*,' what puzzles me is how an engine of her size could be run for days with the outer end of the shaft going down all the time, until it reached 8″ out of line. Now if this engine had been put up that way at the start, I think it would have been found out by trying to put on the caps or the binders, for eight inches even in 40′ or 60′ would show badly; in fact the binders could not be got on. Radical trouble somewhere must have been known in the engine-room, and why they did not stop and run with the port engine is a matter which ought to be explained.

CHIEF ENGINEER.

New York.

[It is not improbable that the fact of serious derangements was known in the engine-room of the '*City of Paris*,' but our correspondent is not aware of the intense competition between competing lines of fast Atlantic steamers. They take all chances, but never stop the ship unless an iceberg looms up right aboard. Fog or clear weather, away she goes, without a check, and so small a thing as "derangement" in the engine-room does not count. The chief engineer is held responsible, and hot or cold bearings he slams her through. Why? Because he does not wish to be the man who made the slow voyage. When the ship makes a quick trip—the captain did it; when she makes a slow one—there is the chief engineer; go for him! he did it. The chief engineer is the one responsible man when things go wrong. When they go right, nobody wants to hear about him. "Who is he, anyway? What's his name?" that is about all the credit he ever gets.

The '*City of Paris*' was a crack ship; the engines have broken down before, but it was not a total wreck and was never made public. This disaster would not have been either, but luckily it could not be concealed.]

◆

PRACTICAL TEST OF THE BELLEVILLE WATER-TUBE BOILERS.

Editors ENGINEER:

The question has often been asked me by engineers how this boiler works on continuous runs using salt water. I will here state for their information that I have just returned in the '*Shearwater*' from a cruise of over 6,000 nautical miles around Cuba and Central American ports, where the water is as salt as any place in the ocean, and the boiler worked finely; no foaming and did not form any scale, although salt water was used freely. I took the caps off the ends of the tubes and put in a lamp so I could see the whole length of the tubes, and there was not the least sign of any scale. Let me say here that this is the only water-tube boiler that you can see into the tubes from the fire room and examine them. All other water-tube boilers are a mass of tubes running athwart ships fore and aft and upright, coupled on to return bends; no one can examine the inside of these tubes without great expense, and then you can't half examine them. During the trip there has not been one cent laid out for repairs, and no repairs are needed to fit us out for the coming season. All there is to do is to clean the outside of the tubes, repack the feed-water regulator, and paint the casing outside of boiler.

ENGINEER.

Boston, Mass.

◆

PROSECUTING ALIEN ENGINEERS.

Editors ENGINEER:

I wish to inform you that we have knowledge of many alien engineers who have obtained naturalization papers by perjury, and you will see by the enclosed clippings from our papers that we have been successful in having two of them held in $1,000 bail for their appearance at court, and we are in hopes of jugging those that vouched for them. I think many of the members of M. E. B. A. will like to hear of our success through THE ENGINEER, especially those on the Great Lakes.

Philadelphia, Pa. ROBT. B. DICK.

[The communications referred to are published elsewhere in this issue, and it is highly creditable to No. 13, M. E. B. A., Philadelphia, that they have been so energetic in these cases. There are some here who need attention, and it is to be hoped that our associations will take the matter in hand at once.]

◆

PERSONS who are working for $1 per day can console themselves with the reflection that they earn nearly twenty-five per cent. more than Methodist ministers in Maine do, if that is any comfort. From statistics presented at the session of the Maine Conference, at Bath, it was shown that the preachers in that conference received on an average last year eighty-one cents per day.

SUGGESTIONS FOR AMATEUR ENGINEERS.

WILL not some of the amateur engineers who conduct alleged trade papers, inform us how it is possible for any steam user to "see for himself that everything is all right," when he does not know what "all right" is, as regards steam engines and boilers? The man without experience is always for enlightening some one who got through the A B C of the trade before the suggester was born. The man with experience minds his own business, no matter what he sees going on in an engine-room.

Almost the first thing a suggester does when he comes into an engine-room is to begin to comment and to "notice." He wants others to know how he would do things, and how much he has learned about steam engines. Most of the suggesters we have ever seen—and they are not few—would be paralyzed in a week's actual service for wages, and make the engine itself sick. A lifetime of hard service about steam engines convinces a sensible man that there are lots of things he has to learn, and one of these which he has learned is to keep his mouth shut in another man's engine-room, as regards the working of the engine.

◆

THE supply of cooled air to buildings during summer is a problem of interest, especially in its element of cost. The air forced into the building by means of the blower is made to pass through a chamber containing ice, usually placed on racks. To determine the quantity of ice consumed is a simple matter. If we supply, say 2,000 cubic feet of fresh air per person per hour, the air being initially at 80° Fahr. temperature, its density will be .0736, and the total weight of the air supply per person per hour will be $.0736 \times 2{,}000 = 147.2$ pounds. To cool this ten degrees (from 80 degrees, to 70 degrees) remembering that the specific heat of the air is .238 will require the abstraction of $147.2 \times 10 \times .238 =$ about 350 heat units per hour. This means, the latent heat of ice being 142.8, that there will be melted, and must be supplied, $\frac{350}{142.8+38} =$ approximately two pounds of ice per hour for each person. Or for each thousand persons in the assembly, the ice consumption for a decrease of temperature of the air supply equal to 10° Fahr. will be one ton of ice per hour, at a minimum cost of about five dollars per hour, or for a session of three hours, fifteen dollars. The expense of the cooling of the fresh air supply is, therefore, so great that it is mainly practiced, and even there only to a comparatively small extent and degree, in places of amusement where admission is charged, and where it thus contributes directly to the income in securing increased attendance.—*A. R. Wolffe, in Stevens' Indicator.*

◆

MACHINE edited papers have superseded the patent inside paper. This latter was a sheet of a certain size suited to the average country paper, and was printed on one side in a factory and sold to country publishers, who then filled up the other side with their own eloquence and local gossip. The new scheme is to print columns only of matter, and sell the electrotyped matter to country publishers. This makes all papers alike, and you can read the same information (?) culled from encyclopedias and farmers' almanacs in all parts of the country at once.

◆

ASSISTANT general manager, promoted from Yale College, enters chair car, calls brakeman, and asks why the car is not warmer. Brakeman answers, "because Baker heater is in wrong end." Assistant general manager asks brakeman to give him number of the car so he may order it sent to the shop for the purpose of taking out Baker heater, and having it placed in right end of the car.—*Nat. Car Builder.*

◆

MRS. ELIZA E. POOLE is a licensed pilot of Massachusetts.

"FOREWARNED IS FOREARMED."

THE '*City of New York*' is a duplicate of the '*City of Paris*,' with the same type of ship and details of construction all through. The pumps, which are to be relied upon in an emergency, are in the same place, and there is but one main steam pipe for the two engines. If this main pipe should be disabled from any cause, bursting, for instance, both of the engines would be out of service. These facts are well known, but will they be changed for the better? We fear not, not even with the experience just bought at an enormous price on the '*City of Paris*.'

◆

IT has probably been observed by all boiler makers that cracks occur oftener at rivet holes or edges on a flanged plate than on others. If plates are punched, it is important that the punches and dies be in good condition. If their corners are worn rounding, so that they will not make a good, clean cut, they will weaken the plate. A punch or die should be in such condition that little or no depression can be observed around the rivet holes. Punches and dies are sometimes used when in such poor condition that the plates have to be laid on an anvil and a sledge used to straighten up the depressio made by the poor tools. Again, when the die and punch are in poor condition, a burr is left on the under side of the hole that has to be reamed or drifted away. A rivet hole in a boiler plate should never be enlarged by a drift pin. The manner of making the seam is important. It has been customary to reinforce longitudinal seams by adding a welt. This is absolutely necessary in order to strengthen the boiler at that point as well as to prevent corrosion, which is liable to occur at the edge of a double-riveted seam when not so reinforced. Thorough annealing of all the plates is important, especially those that are flanged. Even this will not always relieve the flange of all strain on the fibers of the material, especially in the case of throat plates, which are subject to more manipulation than the others Probably the most cracks occur in throa plates on account of the strain caused b flanging, and also because it is subject t more strain from its position in the boiler.—*H. W. Leach.*

◆

THIS is the way the locomotive firema catches it in the *N. Y. World:*

"Imagine him on his knees before th open pit, his face reddened and his eyes distended by the reflected light and heat of th roaring blast, with a poker fifteen feet lon stirring the fire; the sweat pouring from hi face, his hands blistering with heat, and th winter wind cutting his neck and strikin pains between his shoulders. Imagine th baskets of ashes and cinders and clinker that have to be hauled out of the furnac and thrown in the ash box; the puffs of ho air to be inhaled, accompanied by the impalpable black dust from the soft coal an the choking dust and sparks from the smok stack. Imagine the overpowering smell oil from the well-kept machinery, the rapi motion used in polishing it, and the dange ous thrusting of arms and head in the shadow of moving pistons and flying cog and wheels that sparkle like steel and wor with the easy grace of shuttles; imagi him between these duties hanging with h head and shoulders out the window on th lookout for a broken rail or obstruction turn, and you have some idea of his hazar ous calling."

Flying cogs?

◆

PERSONS who know of a better pencil th the Dixon, made by Joseph Dixon Crucib Company, of Jersey City, N. J., are reques ed to send the name of it to this office. W should like to see it.

◆

AN interesting communication up Early American Compound Engines, fr Charles H. Haswell, the well-known eng eer, will appear in our next issue.

AFTER ALIEN ENGINEERS.

James Howden and Captain William Scott, two marine engineers, have been given hearings before Magistrate Smith, of Philadelphia, on grave charges of practicing frauds in order to become citizens of the United States. These are the first charges of the kind made in this country, and will, in all likelihood, serve as test cases for seamen's organizations in the various States. The prosecution is brought by the Marine Engineers' Beneficial Association.

About six weeks ago, at a meeting of the Association, the matter of foreign-born engineers procuring naturalization papers by fraud in order to enjoy the rights of Americans, was brought up for consideration. It was contended that quite a number of natives of other countries had been falsely vouched for and illegally swore allegiance to the United States in order to obtain employment on vessels flying the Stars and Stripes. After the subject had been freely discussed, a committee was appointed with full power to act to investigate the charges. Robert B. Dick was appointed chairman.

A meeting was called of the committee and the members determined upon adopting an aggressive course. Subsequent developments showed that the rights of citizenship had been claimed by wholesale. Silas M. Pettit was retained as counsel and it was decided to proceed upon the Alien Act of 1883. This statute was passed as a relief for seamen of the United States and was designed to protect them from foreign-born engineers and captains. It provides that all engineers and captains sailing under the American flag shall be citizens of the United States.

Information was received by Mr. Dick to the effect that the '*Bluefields,*' '*Bernard*' and '*Brixham,*' three vessels owned by the Baltimore Fruit Company, carried engineers who violated the laws by illegally obtaining naturalization papers. The matter was placed in the hands of the Pinkerton Detective Agency, the court records were searched, and, it is claimed, overwhelming testimony was found. In the case of Howden, who is engineer of the '*Bernard,*' it is said that he declared that he had been fifteen years and seven months old when he came into this country. John Martin, one of the engineers of the '*Bluefields,*' is charged with making a similar statement, while Captain Scott, also of the '*Bluefields,*' is credited with uttering a false declaration.

Howden's application, it is alleged, was recommended by James Mack, an ex-foreman of the Fire Department, and in it he stated that he lived at the home of his voucher. When the detective visited the house, the mother of the ex-city official said that not only did Howden not reside there, but she was unacquainted with the man. Captain Scott is charged with giving his home in Coombs Alley, in the neighborhood of Front and Arch Streets. The operative made a call at the number designated, and found that it was a rag store. The proprietor of the place said it was not a dwelling, that he had occupied it for more than a year, and that Captain Scott was unknown to him. The captain's papers, it is stated, were not obtained until a few months ago, and that he in reality lives in Gloucester.

The three vessels of the Baltimore Fruit Company sailed until recently under the English flag, and when a change was found necessary that of the United States was adopted. At least two of the engineers had lived on board of the vessels.

When these details were obtained by the Pinkerton operatives, a report was made to Chairman Dick, of the Investigating Committee. Another conference was held with Lawyer Pettit, and the prosecution was agreed upon in order to expose the alleged violation. Mr. Dick accordingly appeared before Magistrate Smith, and had warrants issued for the arrest of Howden, Scott and Martin.

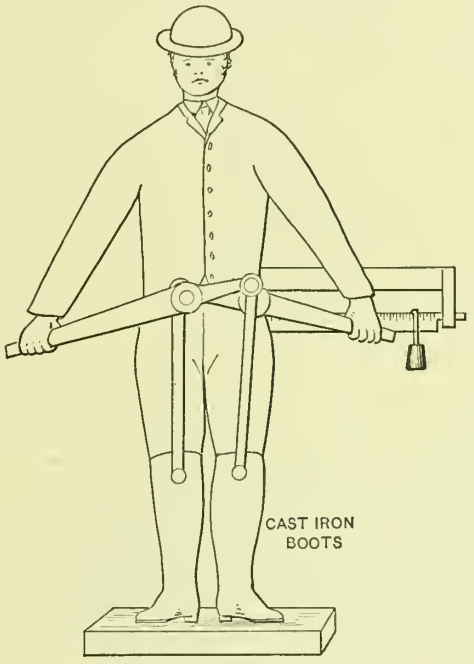
These were placed in the hands of the Pinkerton Agency officials. Howden was first taken into custody on board of the '*Bernard,*' which was lying at Pier 11, and Captain Scott was apprehended later. In some manner Martin became possessed of the information that he was about to be arrested, and when the detective started to serve the warrant the man had disappeared. Martin was traced to New York where the clue was lost. It is supposed that he shipped on a foreign bound vessel. The two prisoners were immediately arraigned before Magistrate Smith, who held each in $800 bail for hearing April 30th, at noon. Bail was entered by Merchant Baizley, of Delaware Avenue.

David Chisholm, a marine engineer, swore that Scott told him that he had tried to get naturalized in New York and Baltimore, but failed. Scott, the witness testified, further said that he got his papers here for $50, the bulk of which he supposed went to the clerk of the court. Bail was fixed at $1,000 for court in each case.

In the course of their investigations in court the Pinkerton operatives claim to have found evidence showing that quite a large number of captains have applied for and illegally obtained naturalization papers. The facts will be laid before the Pilots' Association, which body, it is understood, will closely watch the result of the prosecution by the Engineers' Association. Other arrests will, in all likelihood, follow.

TRACTION INCREASERS.

This gentleman is standing on a platform scale, and he wishes to increase the total load on his feet. He therefore provides himself with the rigging shown—a rigid belt around his waist to which the levers are jointed. Then he pulls with all his might, and is surprised to observe that he does not increase the load on his feet one ounce. This is the principle of a new traction increaser applied to a locomotive in this vicinity, which, it seems necessary to remark, does increase anything. The traction of an engine depends—all other things being equal—upon its weight and steam gear. Both of these are fixed quantities. By throwing the weight of an engine on to one pair of drivers, the traction is not increased a particle. The engine will not haul any more, if as much as before, for one pair of feet, the trailing wheels, have had the weight taken off from them and put somewhere else. This is akin to the cutting an inch off from a blanket and sewing it on the other end to make it longer.



◆

Reports have it that Russian officials have decided that the telephone is "dangerous to the State." In Warsaw orders have been given that telephones be removed from all restaurants, coffee-houses, and liquor saloons. Similar orders have been issued in all other large Polish towns.

In connection with the use of evaporators for making up feed with fresh instead of salt water, for boilers, there is a risk which we believe is not provided for in existing apparatus. When the evaporator delivers the steam formed in it into one of the receivers, then as soon as the heating surfaces of the evaporator become coated with scale, and the conductivity is thereby impaired, the surfaces do not perform the necessary evaporation, and under these conditions the evaporator gradually fills with sea water. This latter, on overflowing, goes up into the receiver, and is likely to cause any of the usual complications due to the presence of water in the cylinders. Again, supposing that the evaporator is so connected that the vapor goes to the condenser, under like circumstances—that is, the heating efficiency being impaired—after the evaporator is full of salt water it will overflow into the steam space of the main condenser, and if no other result accrues, the boilers will receive much salt—the very purpose the evaporator is put in to avoid. If the means of regulating the feed to the evaporator and maintaining the water level therein is not reliable, and so designed that any inflow of water extra to the supply requisite for evaporation will be automatically ejected, the same results may arise from want of attention on the part of the attendant whose duty it is to regulate the supply of water to the apparatus. It is worth the while of manufacturers, and also of the Board of Trade, whose efforts at the present time are being rigorously directed to making the evaporator a machine safe to be placed in the engine-room, not to overlook this very simple, though important, detail.—*Engineering.*

◆

Coal is a substance of purely vegetable origin, formed out of contact with air by long exposure to heat and pressure, from the woody fiber and resinous constituents of a monster vegetation which flourished long before the earth was inhabited by man; and coal may therefore be looked upon as a form of charcoal, which having been formed at a temperature lower than that of the charcoal burner's heap and under great pressure, is very dense, and still retains a quantity of those constituents which, in the latter case, are driven off, as tar, wood, naphtha, etc.; and these bodies consist essentially of compounds containing carbon and hydrogen, together with a little oxygen and nitrogen, and form the volatile matter and hydrocarbons of the coal. Besides the carbon and hydro-carbons, coal also contains certain mineral bodies, which were mostly present in the sap and fiber of the original vegetation, and which gives the ash which is left behind when the coal is burnt. These substances consist chiefly of sulphate of lime or gypsum, silica, and alumina, while in nearly all kinds of coal is to be found a substance called disulphide of iron, or pyrites, which has been formed by the gradual reduction of the sulphates by carbonaceous matter in the presence of iron salts, and which, during the combustion of the coal, is decomposed, giving off sulphur compounds and leaving behind oxide of iron, which gives the reddish brown color to the ash left by many kinds of coal.

◆

In connection with the Thornycroft water-tube boiler it is interesting to note that glass-gauge tubes have been found unsuitable for the high pressure (250 lbs. per square inch) which has been adopted with some of the most recent of these boilers. Up to 200 lbs. per square inch no difficulty is found in using glass, but the addition of another 50 lbs. seems to overtax this material. The difficulty has been got over by using talc, as Mr. Perkins had previously done with his high-pressure steam generator.

◆

Sugar boiled with an acid fruit will be converted into glucose in a very few minutes, two and one-half pounds of which only equal one pound of sugar in sweetening properties.

THE ENGINEER.

FORTNIGHTLY. - - - $2.00 PER ANNUM.

Foreign Subscriptions, - - - - - - 2.50.

EGBERT P. WATSON & SON,

Editors and Proprietors,

150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, MAY 10, 1890. No. 10.

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BEARINGS.

WHAT is actually known about bearings for machinery? We answer, nothing. Is there any standard size for a given load per square inch? There is not. Are there any two bearings by different makers alike in the United States for a given duty? There are not, unless it came about by accident. Are there any standard mixtures for compositions for brasses? There are not; every engineer makes his own. He runs a little more tin, or a little less zinc, or a trifle more copper, just as the notion takes him.

Can anything be predicated as to the action of a bearing large or small? Not the least thing; it may run cool or it may run hot. If it runs hot the engineer in charge takes off the binder and examines it. Possibly he finds the brass badly fitted, so that the bearing touches only upon a third of the working surface. Then the engineer says: "No wonder it heated, three times as much pressure per square inch as I calculated for." Then he refits the bearing, gets all the surface there is, and everything works properly. Nothing heats. All works cool for years. Bye and bye, when he has nothing else to do some day, he looks at that same bearing again, and lo! other parts have got out of line and dropped down—the outer end of a shaft, for instance—and again the bearing surface is all on one side. Three times as much pressure per square inch as he calculated for. Happily the bearing knows nothing about the engineer's calculations, and continues to run cool, no matter what its surfaces in contact are. Every engineer of long experience knows that these citations are correct; he has seen journals running on a ridge of brass, so to speak, which was brightly polished, while all around it the seagreen, sullen bronze shirked its duty. But a fraction of it touched the shaft-bearing. Ruts and furrows, not to say grooves, were worn in the bearing so that the surface looked like a country road in March, but it gave no trouble as regards heating. These things are incontestably true as to the fact cited, and they are certainly puzzling in themselves. We carefully adjust and fit boxes to bearings, and on the outset they heat. They are never in exactly the same contact in after years as in the first hours of their existence, but they develop a surface burnish after the slight asperities left by the fitter have worn away, which materially reduces the friction and tends to make them run easier. Nevertheless, for all this, some bearings are chronic heaters, and nothing cures them, except a change of metals in contact, harder or softer as the case may be. It almost seems, at times, as if crank-pins had antipathies to their encircling brasses, and to their surroundings, even as mankind have.

How do engineers calculate the pressure per square inch per load? We do not know. We do know that it cannot be calculated from the visible surfaces. They are at the mercy of the fitter, who makes a brass bear according to his idea of the fitness of things, and all men do not think alike on this subject. Usually the man who has the least experience has the most positive notions as regards fitting. His idea of a fit is a kid glove, which clings like a curse, if curses ever do cling. If a brass has a half circle of area, the fitter argues that it was made so in order to hold up the shaft, and he puts red lead enough on the bearing to make a red lead fit, then he feels glad that he is such a good workman, and the designer has all the square inches of surface and pounds pressure per square inch that his drawings called for. But there are fitters and fitters, and the one who has had more or less experience in running bearings says that they cannot be expected to run in this condition; so this fitter cuts away the actual contact of bearing on brass until but a third of the latter surface remains, and he reduces this third still further by various grooves for oil, which materially abstracts from the surfaces in contact, so that the original designer of the engines, if he wants to know how much load per square inch is on his bearings, must take the cap off of every bearing and measure it. Then he knows; in any other event he guesses.

Another point and we are through. From time to time various experiments are made in laboratories of science to determine the co-efficients of friction and the lubricating values of certain oils. These experiments are made with delicately fitted-up bearings of finely polished steel upon bolsters of bronze equally well fitted. Upon the results obtained from this apparatus certain values are predicated, both as regards oils, bronzes and co-efficients. With due respect to the experimenters, we submit that such experiments are valueless for practical results. They establish this fact: That under these given conditions—never attained in practice—certain results are reached with the apparatus experimented upon, but it is not fair to the lubricant tested to say that, compared to another lubricant, it is inferior. It is only inferior in that experiment, and may be superior in a majority of cases in every-day work. The co-efficient of friction obtained on an ideal bearing running in a certain uniform temperature is not the co-efficient of the same lubricant running in a commercial bearing in all sorts of temperatures. What, then, is the use of an experiment, when all the conditions are not known and when those of the experiment cannot in any way approach the actual every-day work of a bearing?

Here is an A No. 1 engine oil, let us say, for use on the crank-pins of marine engines. Pressure per square inch is stated to be 800 pounds, and it is desired to test it in comparison with another oil. The only way to do this is to put it in actual service for a given period under the same conditions as nearly as they can be duplicated. Putting these oils on the 3″ bearing of a testing machine with the same pressure per square inch, and same surface velocity as the crank-pin of a marine engine, would not, in our opinion, develop data of value. The surfaces of a 3″ pin and of a 20″ pin are vastly different in convexity, which latter quality affects the distribution and accessibility of the oil in a marked degree.

Moreover, oil suited for a heavy bearing is not suited for a light one and just how the viscosity can be tested upon it we do not see.

The bearings of any piece of machinery are most important details, and too much care cannot be given them both in construction and in running. They absorb the power of an engine to a marked degree when in bad order, and materially reduce expense when in good.

This is easily seen in mills and other places where the friction of line shafting absorbs from 25 to 40 per cent. of the whole power exerted; each bearing has some friction, which, small as it is, amounts to an enormous total in hundreds of feet of shafting. One hole one-sixteenth of an inch in a skimmer does not amount to much, but 40 small holes one sixteenth of an inch diameter amount to one hole 3″ diameter, which is, as one might say, a big hole. This is where the power is lost in a multitude of bearings in bad condition.

BUILT-UP GUNS.

IT is asking a great deal of a built-up gun, with its multiplicity of joints and variety of tensions induced by shrinking on successive rings, that it shall maintain its integrity for any long period. It would seem impossible that each successive discharge should not materially injure it. There is no way of knowing what the actual tension of each ring is, its initial tension we mean. This may be anything, according to the degree to which the ring is heated, and the dimensions of the parts in contact. To make this clearer, suppose we have a rubber tube two inches diameter with one inch bore! A section of this gives a ring half inch thick in its walls. Now distend this ring slightly and it clings with a certain pressure to the expander; extend it more and it clings with increased force up to a certain point, when the elastic limit of the material is reached, and it clings with no greater power no matter how much it is extended. The expansion of a metallic ring is attended with the same phenomena, and we do not think there is any mode of testing by which this can be determined. On the completion of the gun then, there are several sections with various tensions, some of which may, or may not, have already reached their elastic limit. If they have, and they fail, the gun bursts. Many such built up-guns have burst without, possibly, this weakness being suspected. It may be asserted that the methods used in constructing the gun provide for such weaknesses, and the shrinkage allowed for each ring is a guarantee that the elastic limit is not reached, but this is an assertion only, and not susceptible of actual proof, for the reason elsewhere advanced, that the sections are not all—even if forged from the same ingot—of the same tenacity throughout. Example: a bar of round tool steel used to make cutters is put into a lathe and cut into disks with a lathe tool. These disks are not touched with a hammer or heated except to harden them. The stock is just as it came from the original bar, and in its own individual tension, yet some of these cutters will crack in hardening, and others will not harden to the same degree with the same heating. This is a characteristic of steel and follows it in every stage of construction.

A plan which would add, we think, to the endurance of built-up guns and go far toward insuring increased service from them, restoring all parts to a more uniform tension, would be to season them. That is, let them remain untouched for at least eighteen months or two years, before firing a single charge in them. The effect of this would be to bring back the virtue—if we may use such a word—to the various sections, which have been more or less disturbed as to their molecular structure by machine processes. The effect of seasoning on steel is just as marked, in degree, as it is upon timber, but it adds greatly to the cost, and for that reason is seldom resorted to.

ELECTRICAL EXECUTIONS.

WHATEVER the legal aspect of the case may be, it will strike the average man that to keep a poor wretch in jail under sentence of death for months while the constitutionality of the law for his execution is being argued, is a piece of cruelty for which there is no excuse whatever. It takes months and years apparently, to settle what seems to be a very simple matter. The secret of the delay in this case is that an execution by electricity involves several business interests of great importance to those concerned; compared to these the feelings of a condemned man and the public are small matters. One of these interests is said to be that of the company whose machines are to be used for the execution; the other is the publishers of daily papers. These last are stated by a lawyer of this city, to be as follows:

"There are several other questions of minor importance, many of them sufficient, in my judgment, to invalidate this law. For instance, the provision which in effect commands that the newspaper shall publish no report of the killing under penal consequences, except that it took place according to law. It is conceivable that the killing may take place in violence of every statutory and human law. No one can certainly say that a truthful report of the occurrence would not make known such horrible features as to raise a popular outcry which would result in the immediate repeal of the law, but if such should be the case, such a truthful report would expose the publisher and reporter to a prosecution for crime. One of the best conceivable safeguards for the permanent infliction of cruel punishment for crime is to shroud the execution in mystery, and send a truthful reporter of the outrage to the penitentary. This law, therefore, takes away from a criminal an important safeguard against excessive punishment. It is not only an unlawful restriction of the freedom of speech and of the press, but an actual encroachment on the rights of the criminal. Of that encroachment he is entitled in this manner to complain."

In reply to this it may be urged that it is not yet settled that fear of capital punishment has the least influence on persons who commit crimes. Whether they are to die by one method or another matters little, but it seems to a dispassionate observer that it is wholly unnecessary to drag the argument through months in order to settle it for or against.

If the Federal court finds that this law is unconstitutional, Kemmler will be discharged, for the existing law expressly repeals all other laws providing a method of capital punishment. It will also apply to the eight other men now awaiting death by electricity in the prisons of this State.

FAMOUS AMERICAN ENGINEERS. No. 10.

GEORGE H. BABCOCK.

PURSUING the series on this subject we present here an excellent likeness of George H. Babcock, who is so well known as the president of the Babcock & Wilcox Company. Mr. Babcock's life has been an eventful one, and the several occupations he has followed at various periods show the versatility of the man and his faculty of readily adapting himself to circumstances, as well, also, his power of concentration in carrying to a successful termination whatever he has undertaken.

George H. Babcock was born in Central New York in 1832, and comes naturally by his engineering ability. His father was a well-known mechanic, and his mother's family were also noted for their abilities in the same direction. At the age of twelve Mr. Babcock's parents removed to Westerly, R. I., where his father engaged in manufacturing, while the son received his practical education in a woolen factory, in a machine shop, and the common schools of the period, supplemented by one year in an "Institute," as anything above the district school was then called. On returning from this course, at the age of seventeen, he was supposed to be consumptive, and was allowed six months' lease of life. Looking about for some occupation to fill up this interregnum, Mr. Babcock settled upon the then new—or comparatively so—process of daguerreotyping, and followed it. Curiously enough, the chemicals used in the art benefitted him, and he rapidly gained health and strength. Perhaps, also, he had no trace of consumption, in which event the merit of the profession he followed, seems to decrease as an antidote to pulmonary troubles. While he was in this pursuit, Mr. Babcock made the first album, which is still preserved among his curiosities; he also constructed a magic lantern for showing pictures by reflected light, which was the first of its kind to his knowledge. Dagnerreotyping did not fill the measure of Mr. Babcock's ambition, and he soon fitted up a printing office, 1851, and started a weekly newspaper, the first in that section, which he carried on successfully for some years, and is still extant as *The Narragansett Weekly*. While conducting this paper, George H. Babcock and his father invented and patented a new press for printing three colors at one operation. This machine thoroughly accomplished its work, but the trade was not ready for it, and it was not a commercial success, but to it and from it may be traced some of the largest printing press concerns in the country. Mr. Babcock also patented a machine for applying bronze powder to printed characters, and this was used by the Government during the war in printing the metallic ring on the paper currency and bonds in use during that period. At this time Mr. Babcock was designing cotton machinery, and among other things he made a loom which ran at the then unprecedented speed of 240 picks per minute ; in these looms iron was largely substituted for wood. In 1860 Mr. Babcock was a teacher of mechanical drawing at the Cooper Institute, New York, and in 1863, in connection with Charles W. Smith, invented and patented a shrapnell shell which was bought by B. B. Hotchkiss ; it was largely used during the war, and is still the standard shell of its class. In 1862 and 1863 Mr. Babcock was at the Mystic Iron Works, Mystic Bridge, Conn., where many gunboats were built during the war, and later, 1863 to 1868, he was engaged at the Hope Iron Works, Providence, R. I., as chief engineer and draughtsman, building, among other vessels, the '*Rapidan*' and the '*H. S. Hagar.*'

In 1867, in connection with Mr. Stephen Wilcox, he patented the boiler which bears his name, and is admitted to be the first commercially and practically successful water-tube boiler made. As this series is in no sense a business transaction upon our part, we do not allude to this portion of Mr. Babcock's record in greater detail, concluding our notice by mention of the fact that the work "*Steam,*" compiled by Mr. Babcock in connection with their business, has reached an edition of 100,000 copies, and is used as a text-book in many technical schools.

Mr. George H. Babcock has held many honorable positions in engineering societies. He was the sixth president of the *American Society of Mechanical Engineers*; non-resident lecturer upon engineering, *Sibley College*, Ithaca, N. Y.: member of *A. S. M. E.*, *American Inst. Mining Engineers*, *American Meteorological Soc.*, *Am. Geog. Soc.*, *Historical Soc. of New Jersey*, and *Metropolitan Museum of Art*.

Mr. Babcock, it is pleasant to add, has amassed a handsome fortune from his professional labors and is just in the prime of life, as his portrait herewith shows.

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CAPTAIN GEORGE M. NORTON, an American sea captain and editor and publisher of the *Marine Journal*, of this city, is making strong efforts in his paper to secure the rights of seamen and vessel-owners alike. Captain Norton does not hesitate to call a spade a spade, knowing full well that all sensible men, for or against him, are more apt to listen to plain speech than to mealy-mouthed insincerity.

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STATISTICS of the Inspection Service show that there are 6,744 steam boilers in use in this city.

Foreign and Domestic Trade Literature.

THE ACCIDENT TO THE 'CITY OF PARIS'.

The skin plating of the '*City of Paris*' is, and has been throughout, as sound and uninjured as on the day the vessel was launched, and we learn on excellent authority that such is the case, the outer skin being absolutely uninjured, and not even the cement disturbed.

On arriving in the Mersey the '*City of Paris*' was taken into the docks on the Birkenhead side, and was first placed under the 100-ton crane in order that some of the heaviest parts of the debris of the smashed-up engine might be lifted out. This done, the ship was berthed. On the water being pumped out of the dock it was seen that something was wrong with the starboard propeller shaft. The propeller itself was uninjured, the three blades not being bent, but it was seen to have shifted somewhat aft of its normal position. The shafting passes through the skin plating in the usual way, and the outward length of shafting is inclosed in steel plates. The casing extends up to the bracket which supports the after end of the shafting, and is attached to the ship's side by a web of steel. It became necessary to strip off this casing in order to make a proper examination, and Laird Brothers, in whose hands the work had been placed, proceeded with the operation. Upon the casing being cast adrift, the whole of the outer lengths of shafting, with the propeller attached, fell into the bottom of the dock, one blade cutting deeply into the timber of the dock bottom, while another was curled up like a leaf. It was in this position that we saw the shafting and propeller on the 11th inst.

Each of the twin shafts passes through a stern tube, in the usual manner. Immediately outside there is a flange coupling of the ordinary description, by which attachment is made to the outboard length of shafting. It was immediately on the forward part of this coupling, and directly outside the stern tube, that the starboard shaft was broken square across. The fracture was thick with rust on both faces, but there was every appearance of the metal being sound throughout. The outboard portion of the shaft abaft the coupling just referred to consists of one length of hollow shafting 42 ft. long, and one length of solid shaft 15 ft. long, this latter carrying the propeller. The total length of shafting abaft of the point of fracture was thus some 58 ft. or so.

This breakage of the shaft will, of course, fully account for the racing of the engine while the subsequent damage done thereby can, we think, also be fully accounted for. Proceeding aft in our examination of the vessel we found the two arms of the stern bracket intact, their attachment to the vessel being undisturbed. At their outer ends they were connected by a cylindrical boss which forms the support in which the propeller shaft revolves. This boss, with the two arms and their palms by which they are attached to the hull, form one steel casting in the usual way. The thickness of metal in the cylindrical part is 3½ in. The boss was fitted with the usual gun-metal bush and lignum vitæ bearing strips. The cylindrical part of the casting was split clean across the top in a line with the axis. The reason of this was obvious; when the forward end of the broken shaft had commenced to fall, owing to losing the support of the casing, a twisting moment of considerable force was naturally exerted, and this the casting was unable to sustain. The length of the cylindrical part of the bracket is about 6 ft.

We have said that the top part of the bracket was split across when the twisting strain was brought upon it by the release of the forward end of the outside shafting when the casing was cast adrift in the dock. The bottom part of the casting was worn through for nearly the whole of its length, and much reduced in thickness where not worn through. The metal liner, 1 in. thick, together with its end flanges, was also worn through, and was lying in the bottom of the dock. The brass sleeve of the propeller shaft had entirely disappeared with the exception of two rings, presumably the collars at the end. The propeller shaft itself was practically undamaged, but the metal studs which attached the sleeve to the shaft were wore down level with the shaft and the shaft was slightly worn also.

This wearing away and consequent dropping of the end of the outer shafting we take to be the obvious primary cause of the whole mischief. Our readers will easily imagine the abnormal and altogether unprovided for stress thrown upon the shaft through its after end dropping some 7 in. or 8 in., and the fracture naturally occurred exactly where one would expect, namely, adjoining the next point of support; the latter being provided by the stern tube where the shafting emerged from the ship's skin.

What may have been the cause of the wear of the propeller shaft and its bearing and their support remains a question yet to be solved. Upon this we can offer nothing but surmise. The bearing was, as we have said, fitted with lignum vitæ strips, and it is an interesting point to determine what happened to these strips. Those who have had the best opportunity of forming an opinion on the subject, are agreed that the brass liner on the tail shaft probably burst, that the rough edge cut out the wood, and that the metals then came together and ground each other away, producing the state of things described. This appears to be a reasonable explanation.

In addition to the complete fracture and severance of the end of the stern tube shafting, as already described, there was a fracture at the extreme after end of the outboard shaft, caused, doubtless, by the fall to the bottom of the dock. This shaft—which, as we have already said, is hollow—is attached to the propeller shaft by a flange coupling of the ordinary description, and therefore it will be seen that the fracture occurred close up to the collar of the shaft; in a position, in fact, corresponding to that of the fracture of the other shaft. This second fracture did not extend right across the shaft, but could be traced about half round the circumference.

To these particulars it may be added that on the casing which inclosed the outer shaft there was a depression, in part worn right through, but this, we take it, was caused by the friction of the shaft coupling, due to the rotation of the propeller after the breakage, owing to it being dragged through the water when the ship was being towed, or when she was steaming from Queenstown to Liverpool under her port engine. * * *

The damage occurred almost entirely to the low-pressure engine, and some idea of the nature of the smash will be given by the engraving which we publish, showing the aspect of the engine-room after the accident. These views are reproduced from two photographs supplied by the Inman Company, these photographs having been obtained by pointing the camera almost directly downwards. The two illustrations thus represent two plans of the debris taken from slightly different points of view. It may further aid in appreciating the extent of the disaster, if we mention that the low-pressure cylinder, one portion of which occupies a central position in the lower view, weighed 45 tons, while the weight of the low-pressure piston was about 10 tons, of the piston-rod 3 tons, of the crosshead 2 tons, and the connecting-rod 7 tons. The crank-shaft weighed 14 tons. The engines are mounted on a massive steel bedplate weighing 48 tons, while the two standards supporting the low-pressure cylinder weighed about 14 tons each.

We will now proceed to give some detailed account of the damage done inside the vessel. Passing through the starboard engine-room, we proceed to the starboard tunnel. Here we find the shafting supported by four bearings, and in each case the caps have been broken off; but, so far as we could perceive, no damage had been done to the shaft. The break strap lugs had been broken off, but there was no sign of more than ordinary wear upon the flange on which the strap engages. The journals of the shafting were also in good condition. At the transverse partition forming the forward end of the tunnel, the plating was torn and doubled up to a height of about 6 in. above the shafting. In the dynamo-room, through which both port and starboard shafts pass, there are two bearings to each shaft; both of those belonging to the starboard shaft have their caps split. The bulkhead between the dynamo-room and the main engine-room is damaged in much the same manner as the other bulkhead.

From what has been said it will be gathered that the shafting must have risen bodily when the accident occurred; but, as the stern tube is intact in its position, so far as our observation went, there must have been some bending of the shafting. The couplings of the various lengths have, however, stood the test.

On entering the engine-room the first thing to attract our attention is the thrust block. There is not much of it left, however, as the whole of the thrust caps, which are of the horseshoe type, were forced from their places, exposing the shaft with its ten thrust collars.

The highest part of the wreckage at the time of our visit consisted of the fractured fork or **A** part of the engine framing on the port side. Each leg of the split part is 15 in. in length (fore and aft) and 3 ft. across (athwartship). The metal, which is steel, averages about 1½ in. thick, roughly speaking. So far as we could observe, there was no flaw in the castings. On one of the broken pedestals there was a large piece bent inwards, the deflection being about ¾ in. in a length of 9 in. The parts of the broken standards which stood highest were, as we have mentioned, those on the port side. On the starboard side the framing was broken off to within a foot or so of the bedplate.

The low-pressure crank itself lies on the top center. In the illustrations the massive fractured halves of the low-pressure cylinder are a prominent feature. Descending into the crank-pits, we found the transverse framing badly fractured. The caps of the main bearings were split clean across. One of the holding-down bolts of the main bearings, that of the after low-pressure bearing, was broken clean across level with the upper surface of the framing; the corresponding bolt in the other bearing was much bent; these bolts are 5½ in. in diameter.

The inner bottom below the crank-pit is certainly perforated, but to what extent we were unable to see owing to the debris superimposed. The webs of the crank, which are built-up, have both shifted on their shaft. The movement of both is forward, and of small amount, probably not more than an eighth of an inch. It may be that the crankshaft itself is bent, but, if so, the deflection is not sufficient to enable a positive statement to be made.

Emerging from the crank-pit, and taking a general view of the wreckage from above, we find the connecting-rod, which is 11¼ in. in diameter, still attached to the crank-pin, lying horizontally towards the starboard side. It has a considerable bend in it, say, of 1 ft. to 1 ft. 6 in. radius, a foot or two below the fork of the top end. The piston-rod is still attached, and this lies doubled back towards the starboard side. The piston, which is of the dished type, was attached to this rod by eight 3½ in. bolts. These passed through the piston and through a collar on the piston top; the bolts remained in the collar but the piston itself had been broken away, only a very small part of it on one side remaining attached to the bolts. Beyond the collar the piston-rod is continued so as to form a tail-rod. This has been bent almost at right angles to the other part.

The low-pressure cylinder itself was supplied with steam by means of four cylindrical valves, two on the forward and two on the after side of the cylinder. For this reason the cylinder casting was much stronger on its forward and after ends than at its sides, and when it broke up it naturally split in an athwartship direction. It broke into two main portions, and fell in the position shown in our illustration. The piston was also split into two main parts, and one of these pieces, found below one of the cylinder halves. The cylinder cover, which, like the cylinder, is of iron, was not so much damaged as the other parts, although it was much battered and had a piece weighing a few hundredweights knocked off one side.

The webs of the crank are much battered and scored especially on their outer ends. One dent on the edge of the forward web was 6 in. long and 3 in. across, being scooped to a depth of about 1¾ in.

The fork end of the connecting-rod with the cross-head lies on the site of the air pump, which may be said to have entirely disappeared. One of the side levers, bent and twisted in most fantastic forms protrudes from the general mass of the wreckage. The surface condenser is of cylindrical type, unattached to the engine. It has been breached by the swinging round of the connecting-rod, so that a large part of the side is knocked away and the tubes displaced. It was in this way that water obtained access to the ship; had there been time to close the inlet and outlet valves the water would not have risen in the compartments and the vessel would have been able to proceed under her port engines.

As our readers are aware, the port and starboard engine-rooms are divided by a fore-and-aft bulkhead. This bulkhead has a door at the lower flat, and this door was open at the time of the accident but was closed immediately. The point as to whether the door was open or shut is, however, not of such great consequence as it otherwise would be were it not that the bulkhead is pierced by three holes. One of these is about 8 ft. above the floor-plate. It is circular and about 8 in. in diameter, and was, perhaps, punched by the tail end of the piston-rod. Another hole is a foot or so further aft and is a more irregular shape with, perhaps, not quite so large an area of opening; the third is smaller and further forward. The vertical plating of the well above the engine is much battered and dented to a height even above the upper deck. One large bulge in particular is but a few feet below the promenade deck. As this is far beyond the range of any of the attached moving parts of the engine, even the top end of the tail-rod, it must have been caused by some flying missile, and that of considerable weight.

As we have already seen, the primary cause of the disaster was undoubtedly the wearing away of the boss of the bracket supporting the stern end of the propeller shafting, this leading to the fracture of the shafting outside the stern tube, and hence to the racing of the engines. Of course such racing, if unchecked, would soon induce strains on the connections of the reciprocating parts amply sufficient to cause the destruction of the machinery; but rapidly as this would occur, some brief interval would intervene before the necessary speed was attained, and from the fact that on the present instance—as far as can be gathered from the evidence available—the smash occurred almost immediately on the engines starting off and before any effort could be made to shut off steam, it almost appears as if some special influence had been at work to effect at least a portion of the damage. One theory, we consider worthy of some consideration, is as follows: It is well known that in the low-pressure cylinders of modern marine engines there is considerable difficulty in getting the amount of cushioning desirable to insure smooth running at the speeds now common, and hence there is every inducement to increase that cushioning (chiefly by inside lap on the low-pressure slide valves) to as great an extent as non-interference with a clear exhaust will permit. What the proportions were in the case of the engines of the '*City of Paris,*' we do not know, but probably they agreed with usual first-class practice. Now when the engines started to race two influences at once commenced to materially increase the compression in the low-pressure cylinder. In the first place, the condenser (fitted with separate circulating engine), received a great increase in the amount of steam it had to deal with, thus probably materially reducing the vacuum, and secondly, the increased piston speed would give rise to an increase in the difference between the back pressure in the cylinder and the pressure in the condenser. These causes would thus augment the pressure in the cylinder at the commencement of compression and instead of being, say, as ordinarily, some 4 lb. to 5 lb. per square inch absolute, it might readily rise to three times this amount or more. The effect of this would be to produce a serious pressure at the termination of the compression, and the valves on the low-pressure cylinder, being of the piston type, the only relief for this pressure would be through the ordinary relief valves—quite inadequate for such an emergency as this. It is very easy to conceive that such a condition of things as we have assumed might lead to the blowing off of the top cover of the low-pressure cylinder and other damage, which would leave the high pressure and intermediate sections of the engine temporarily free to run as a non-condensing compound engine, thus accumulating speed which would complete the destruction. On this latter point we may observe that the strain on the connections due to the stopping and starting of the reciprocating parts would increase as the square of the speed, so that, even if these connections had as large a factor of safety as 9 at the normal speed of the engines, this margin would have entirely disappeared by the time a threefold speed was reached.

It may be said that the worst has happened which could happen, to the starboard low-pressure engine of the '*City of Paris.*' A comparatively small cause has led to this great event, from which many important lessons may be learned. The benefit of this experience will be shared not only by the owners of the '*City of Paris,*' but by those interested in other large steamers of a similar kind; so that this breakdown will make a voyage across the Atlantic safer than before, and this advantage has been purchased without the loss of a single life, although at great sacrifice of property.

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It is a little singular that when you show men that a foot is 12 inches, and that a pound is 16 ounces avoirdupois, and that by no sort of mechanical devices they can change these dimensions so as to give them greater value without corresponding outlay—they will still go to work on machines which are impossibilities. Then, after they have spent a lot of money and found out the truth of our assertions, they say: "Yes, you were right." It seems to be a very satisfactory experience to a great many.

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As Herbert Spencer has ably demonstrated, the progress of all development is from a state of less complexity to one of greater complexity, and the law applies to marine engines as well as many other things.

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The total strength of the English Marine Engineers' Union was 4,306 according to the last returns, and the strength of the profession was 60,000, of whom 23,000 were in active employment.

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The *American Machinist* has recently added four pages to its form, and now appears as a 20-page paper, with the subscription price at $3 in lieu of $2.50 as formerly.

ERICSSON AND HIS 'MONITOR.'

The story of the '*Monitor's*' building has been often told, but the minor mishaps, the special incidents which, apparently adverse, yet proved providential as contributing to that exact coincidence of time, place and circumstance upon which so much depended, have as yet been omitted in the telling, and without them the story is incomplete.

While the vessel was on the stocks, Captain Ericsson made frequent and for a part of the time daily visits to the yard of the Continental Works, watching operations with a keen and critical eye; but after the launch he considered this no longer necessary, and visited her but seldom. In this way it came about that, although the main engines were put in before launching, he did not see them under steam, but contented himself with the reports of their action made by the Government engineers. These engines were of what has ever since been called the "Monitor type," and many have supposed that they were, like the vessel itself, of wholly novel and untried design. This, however, was not the case. In the '*Judith*' and the '*Daylight,*' and elsewhere, this form of engine had already demonstrated its practical working qualities, otherwise the captain would probably have given the first trials at the dock his personal supervision.

For obvious reasons, as little publicity as possible had been given to the work during its progress, but perfect secrecy was, of course, out of the question. The turret of a monitor cannot be hidden under a bushel, nor could the launching of an iron-clad vessel be concealed from the public eye; and, indeed, it had been watched by some in expectation that this strange craft, built in defiance of everything considered ship-shape, apparently overweighted with iron, and with no free-board worth mentioning, would slide off the ways straight to the bottom of the East River and never come up again. Disappointed of this sensation, the public had manifested no little curiosity to see how the "Ericsson Battery" would behave when she left the dock. This curiosity was soon gratified; the final preparations were pushed with unabated vigor, and the engines having been reported in satisfactory working order, upon one gloomy winter's day a formal trial trip was made.

The result of this trial was anything but encouraging, as reported in the daily papers, one of which made it the text of a "crushing" article, wherein, under the heading of "Ericsson's Folly," the battery was pronounced an ignominious failure, which could neither be propelled nor steered; the captain was called an incapable schemer, and a stern reproof was given for the sin of thus wasting the country's resources; no words too harsh, no denunciations too severe, for the zeal of this fiery crusader. The versatility of the modern journalist stood him in good stead on the 10th of March, when the novel fighting machine had proved invulnerable to heavier blows than his pen could deal: but in the mean time it must be admitted that the battery had not behaved as well as she might. The motive engines were not in proper adjustment, the steering-gear required excessive power, and between the two the vessel proved unmanageable; the trial was given up, and she had to be towed back—a rude disappointment indeed to expectations which no one conversant with all the facts can regard as unreasonable.

It is well known that John Ericsson was by nature sanguine and enthusiastic; impetuous, excitable and impatient of contradiction; nor did he always in the heat of the moment consider whether his wishes could be executed by those not endowed with his own tireless energy. The events of that dismal day must have vexed his very soul, but the manner in which he bore them was strikingly characteristic. Had they been trifling things, he would have been exasperated, as his custom was, and exasperating, too, when small affairs went wrong; but under heavy burdens his broad shoulders never bent, and he looked always squarely in the face of grave misfortunes with calm and resolute eyes. It is true that on his return to Franklin street, where he then resided, there was a somewhat portentous cloud upon his face, and no wonder; but it was not the forerunner of a storm.

At his request I brought the drawings of the valve-gear, not without misgivings, for he had never examined them with a view to verification, and I alone was responsible for their accuracy. He wanted the plan showing the relative positions of the eccentrics and the main crank, and I was obliged to explain that I had no original, having made the working tracing, in order to save time, from detached drawings and a pencil diagram. He listened with patience, and appeared satisfied with my detailed explanation, and then requested me to make a new drawing of the complete arrangement, trace it, and as soon as possible to call in the old plan, give out the new one, and give orders to have the eccentrics at once set according to it. I was then informed that during all the trials at the dock the engines had been running *backward*, of which Chief Engineer Stimers, who, it seems, had never inquired whether the propeller was right-handed or left-handed, was not aware. Simple reversal would not, at best, have fully met the difficulty; for each slide valve was driven by a loose eccentric, which was shifted part way round in order to reverse—an arrangement which, if adjusted to give the best results in one direction, will not in that type of engine do equally well in the other. Still this could not have been the whole secret, though it was never discovered just what was; for the subsequent difference between the forward and backward running was never great enough to have caused so much trouble; and, again, the same device was used in many engines of the same form afterward, about which no complaint was made.

Be that as it may, I did not feel like taking the responsibility of giving out the new plan without his scrutiny; but he would not look at it, only saying: "You are sure it is right now? Very well; then go ahead." I did so, and, having captured the first tracing, lost no time in comparing it with the new drawing; to my great relief they tallied exactly, so that both tracings might have been made from the same original plan.

Some time after, meeting the superintendent of the Delamater Works, I tried to ascertain the real cause of the difficulty, but without success. He asserted that the first drawings of the valve-gear were all wrong, admitted that the new ones were all right, and averred that the plans had been carefully followed in both cases. After a brief explanation, I invited him to accompany me to No. 95 Franklin Street, and compare the old with the new, but he found that he had not time. Captain Ericsson had once described this superintendent as "too stupid to make a blunder," which only proves that his own judgment was not infallible; but whatever the precise nature or cause of this annoying maladjustment, it is absolutely certain that it was due to no error or oversight at headquarters. And it was so quickly rectified that the trifling delay arising from this cause alone would not have prevented the '*Monitor*' from meeting her adversary before the eventful 9th of March.

She had become unmanageable, not only from the temporary failure of her engines, but from want of control over her steering gear. The cause of this was that her rudder was somewhat overbalanced, the area forward of the rudder post being too great in proportion to that aft of it. In these circumstances, the rudder, once thrown over to either side, does not readily return, but opposes considerable resistance to any effort to bring it back to its central position. Those who choose may attribute this to miscalculation; but it is for them to prove that under all the conditions, known and unknown, the exact proportion which shall require the least power can be determined by any known means. At any rate, there was the hard, uncomfortable fact; it was not the hour, nor was Ericsson the man, to indulge in idle speculations as to how or why it came there; but had he adopted the remedy suggested to him, it is morally certain that the battle between the giant and the pygmy would not have occurred when and where it did.

This remedy was neither more nor less than the replacing of the balanced rudder by one of different form. I do not know where the idea originated, nor do I say that any formal proposal was made, but in some way the captain became aware of an intention of the naval authorities to have the vessel put in the dry-dock and fitted with a new rudder. The hot Scandinavian blood flushed his cheek, his eyes gleamed, his brow darkened, and this time the storm broke in all its fury. With the full volume of his tremendous voice, and with a mighty oath he thundered: "The '*Monitor*' is MINE, and I say it shall not be done." Presently he added, in a tone of supreme contempt: "Put in a new rudder! They would waste a month in doing that; I will make her steer just as easily in three days."

My recollection is that it was done in less time. No change in the rudder was even thought of, and the change in the steering gear was the simplest possible. Her tiller consisted of an arc of iron, with two angle irons on the outer side; round each of these was wound a chain, which, running around a pulley below the deck, was attached to a wire tiller-rope leading forward to the pilot-house, and coiled in the usual manner round the drum of the steering wheel. By Captain Ericsson's direction, the wire ropes were now detached from the chains, to each of which a snatch-block was made fast, a short chain was connected at one end to each tiller-rope, run through one of these blocks, brought back parallel to itself, and secured at the other end to a deck beam. The purchase being thus doubled, the trouble was over, and the vessel steered with ease.—*Prof. MacCord in North American Review.*

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PROTECTION OF CHIMNEY SHAFTS FROM LIGHTNING.—No. 2.

Materials for Conductors.—Iron and copper are the only two metals which can be advantageously adopted for lightning conductors. The Lightning Rod Conference recommend copper, but do not put it much before iron. If the latter be used it should not weigh less than $2\frac{1}{4}$ lb. per foot run. Copper has the advantage on the score of durability; on the other hand, it is much dearer than iron, and is more easily melted. The principal objection to iron is its liability to oxidation, but this is in a great measure prevented by galvanizing. As iron rod, on account of its rigidity, cannot be used in long lengths, many joints have to be made, which is objectionable, because these joints are liable to rust, and thus destroy the metallic continuity. Copper has been generally adopted in England for many years past as the proper metal for conductors attached to all important structures, including chimneys of note. In America and the Continent, however, iron is much more in vogue, and has stood the test of a very long experience.

Mode of Attachment.—There must be no insulation, and the copper tape should be fastened to the chimney with holdfasts of the *same* material, to prevent voltaic action. The holdfasts should be driven in just tight enough to support the tape without distorting it, and so as to allow play for expansion and contraction. The conductor should be placed in such a position as to be least liable to corrosion from the gases, and also, if possible, where the extremes of temperature are at a minimum. An allowance in the length of the conductor has to be made for contraction and expansion—1 in. in 40 ft. is sufficient. Slight bends in the tape, if not too abrupt, answer this purpose very well. The bends necessary for passing over and through cornices and mouldings should be eased, inasmuch as lightning is apt to take a direct course, jumping over sharp turns in a conductor; in other words, the latter should be as straight as possible. The tape should not be bent at a greater angle than 30 deg. at any point of its length. As copper is a valuable metal, and offers a temptation to thieves, the tape should be carried in wrought-iron gas tubing for the 10 ft. or 15 ft. above the ground surface and for some few feet below it. It is considered best to connect the conductor electrically—*i.e.*, metallically—to all metal in the chimney, such as strapping and metal caps. Conductors are sometimes duplicated, which is a good method, as it facilitates testing for electrical conductivity, etc.

Earth Terminal.—This portion of a conductor is of equal importance to the rest, and expense should not be spared to obtain a very good "earth." The best "earth" is water, and when a deep well or other large body of water is close at hand, the conductor should be carried down into it. The Lightning Rod Conference advised soldering the end of the conductor to a plate of metal (copper to copper and iron to iron, to avoid voltaic action) at least 3 ft. square and $\frac{1}{16}$ in. in thickness, buried as deeply as possible in a damp spot. A good earth may also be made by coiling the end of the tape or rod in a few tons of coke or ashes deposited in a soil which is always damp. The addition of a bag or two of salt is recommended, or rain water may be led there from roofs by stoneware pipes. Under all circumstances there should be a good, deep, damp "earth," and this can usually be obtained by boring, where other methods are not available. It is still better practice to have a duplicate "earth," bifurcating the conductor underground, and carrying each branch to a separate metal plate; the latter being surrounded, as before stated, with coke or ashes, which are good conductors of electricity. When there are gas or water mains in the immediate neighborhood, the conductor should be connected to them metallically for their own protection; otherwise the lightning may jump across to them and injure them. Such mains, however, must not be relied upon as terminals, because they are often in dry weather badly earthed. When the mains pass under or have branches entering the building, it is best not to connect the conductor to them, but rather to place it as far as possible from their neighborhood.

The painting of a copper conductor is optional, but an iron one is usually both galvanized and painted.

Inasmuch as an ordinary chimney shaft is seldom built alone, but usually stands close to an engine-house or factory, it is not out of place to add a few words as to how these buildings may be protected. Terminal points are generally erected at the ends of all ridges, and they can sometimes be made a slight feature in the architectural design. The conductor should run along the ridges, and may be provided with short terminal points at intervals. It should be carried down all hips and corners of the structure to "earth," so as to cage the latter in, as far as possible, with metal. The different branches of the tape or rod should be taken to a good deep "earth," and by preference to earth at several points, care being taken —as before stated—to have soldered joints and to avoid galvanic action, etc. Rain water spouts, vanes, finials, etc., and all outside metal should be in perfect metallic connection with the lightning conductor, and, generally, with one another; but it should be kept well away from soft metal and small bore pipes and from internal gas pipes of every kind. Some judgment is required in this matter as in that of connecting to water and gas mains. A cheap method of protecting a building, and one which is recommended on high authority, is that of using ordinary stout galvanized telegraph wire for the conductor, carrying it up all corners, along all ridges, hips, and eaves, and up chimneys, taking it down to "earth" in several places, and at each place burying a load of coke or cinders. It stands to reason that, whatever style of conductor be adopted, the general course of the path offered to the possible flash of lightning, from sky end to earth, should be as direct and as vertical as possible. For instance, right angled changes of direction in the conductor from the vertical to the horizontal and back to the vertical, in order to avoid a roof or to lead it from one face of the building to another—as is occasionally to be seen in the case of lightning rods attached to modern structures—should be avoided. The course chosen should be one more or less diagonally downwards—*i.e.*, one making a considerable angle with the horizontal.

Finally, when the lightning conductor is in place it has to be electrically tested, an operation which is best entrusted to an expert. This testing has to be repeated from time to time in order to ensure the conductor being in working order; and to make provision for this a wire is sometimes, in the first instance, metallically connected to the upper end of the conductor and brought down to the base, being attached to the structure in the same manner and with the same care as the conductor itself. If this practice were universally followed, the periodical testing of conductors would not be so much neglected as it undoubtedly is.—*Industries.*

MANAGEMENT OF HIGH-PRESSURE MARINE BOILERS.—No. 2.

As there appears to be some diversity of opinion as to the amount of boiler scale which may be allowed upon the heating surfaces, let us look at this question from three points.

(1) Present safety; (2) Efficiency of the surfaces for the transmission of heat, and (3) Preservation of the internal parts from corrosion or pitting.

Taking the first point, experience shows that while scale upon such parts of the boiler as the outer shell and stays is immaterial, its presence on such parts as furnace crowns, back-tube plates, and combustion chamber plating, where the heat is most intense, is dangerous, and a very thin deposit here is sufficient to produce collapse, or cracked or bulged plates. Further, on all the riveted joints exposed to the action of the flame, unless kept very clean, the resistance to the transmission of heat, opposed by the extra thickness of plate, causes the part nearest the fire to become overheated and crack at the rivet holes, and leaky seams are the consequence, which may soon become a source of actual danger to the boiler.

With regard to the second and third points, it is unnecessary to remark that the cleaner the heating surfaces are maintained, the more efficient they will be in transmitting heat, and consequently, the more economical in fuel will the boiler be; but on the other hand, a thin scale has been found the best protection against corrosion. If a very thin coating of scale can be got to properly adhere to the plate, complete protection is obtained, and this is not bettered in any way by putting on a thicker coating, nor is the adherence of a thick scale any greater than that of a thin one. Therefore a scale $\frac{1}{32}$ of an inch is quite as good for protection and not nearly so bad for resisting heat as one of $\frac{1}{8}$ of an inch, while no scale at all is required upon parts which show no tendency to corrode.

A green deposit is sometimes found in patches on the bottom of furnaces and on the shells of boilers below the fire-bar level: this consists principally of some salt or copper, probably carbonate of copper; the presence of copper being shown by the green tint a portion of the deposit would give to the blue flame of a spirit-lamp.

This copper could have been introduced into the boiler with the feed water, and has come, no doubt, from the condenser tubes or feed pipes being acted upon by the acid produced by the partial decomposition of the cylinder oil used. By adding a small quantity of copper salt in solution to water containing any alkaline carbonate, such as soda or carbonate of lime (small quantities of which are always present in sea water), the salt would be decomposed and carbonate of copper produced, and this being insoluble will be deposited on the surface of the plate in a similar manner to ordinary scale.

In cylindrical boilers, in which the feed water is delivered low down, the cold feed, being heavier than the hot water in the boiler, sinks to the bottom, and hence the parts of the boiler at the level of the fire-bars are nearly always colder than the boiling point of the water, and if the proportion of copper salt is small as compared with the carbonates in the water, and the amount of copper must always be very small,it will very likely be all decomposed almost as soon as it enters the boiler, and this will account for the deposit being found in the lower part of the boiler.

A word or two in conclusion on corrosion. Many theories have been advanced to account for the presence of this active and troublesome enemy, but I think one that will command the respect of practical marine engineers is that of the presence of moist air in the boiler, and the fact of feed-heaters being more generally adopted now speaks strongly to the general acceptance of this theory.

All water absorbs air at ordinary temperature, but expels it when heated, therefore by heating the feed to boiling point before pumping it into the boiler we get rid of nearly the whole of the air it held in solution. Feed-heaters, therefore, tend to prevent corrosion in a boiler and to diminish the quantity of zinc required to preserve the boiler.

The presence of air in the water and steam in the boiler is detrimental another way. Air is a bad conductor and an absorbent of heat; and its mixture with water prevents a very rapid heating of the water. Means are provided in heaters to allow this liberated air to escape, and so add to the efficiency of the steam producer.—*Engineers' Gazette.*

THE INSTABILITY OF SOLIDS.

It has often been observed that the form of castings is altered by changes in temperature. This is seen in the varying and warped shapes of malleable castings after being annealed. Another instance of this kind, where the range of temperature to which the metal is exposed is not so great, is that of double disk throttle-valves used on locomotives. No matter how carefully these are ground, and how tight they are made when the engine is new, they nearly always leak after being exposed to steam for a few hours or days. If they are then reground they will remain tight. The same experience often occurs with tubes. They may be calked so as to be perfectly tight when the locomotive leaves the shop, but will leak after being in service a short time. If they are then recalked they will usually remain tight. The reason of this apparently is in the first case that the metal in cooling, after being cast, is in a state of internal strain. On being heated to a temperature considerably less than the melting-point, this strain is relaxed and a change of form results. By repeatedly heating and cooling, and thus relaxing these strains, this internal strain assumes a condition of equilibrium; and the form of the casting will then not be affected by further changes of temperature.

There are many illustrations in common experience of this action, as in the case of cast-iron car-wheels, which must always be annealed, because if they are not they are liable to break in service. A curious instance of this occurred in the experience of the writer. He had in his possession a $\frac{1}{2}$-in. hardened steel cylindrical gauge which fitted perfectly into a ring of the usual form made for such gauges. This was kept in a morocco case lined with silk and plush, and kept in the editorial desk where no one had access to it but the writer. It was never used, excepting to exhibit it as a curiosity, and was not used in that way more than perhaps half a dozen times in all. After resting quietly in the desk,for somewhat less than a year, it was found that the plug or ring, or both, had in some way changed their dimensions so that the one would shake sensibly inside of the other. There is no doubt that they fitted each other at the beginning of the period named, as near perfectly as could be ascertained by the sense of feeling, and it is equally certain that they did not fit each other at the end of the time referred to. There is no probability that they were handled during that time by anyone but the writer, or by some one in his presence, or that they were tampered with by any other person. Now what is the explanation? There can be no doubt that metal exposed to high and then to low temperature changes both its form and dimensions, as in the case of locomotive tires, which will be somewhat smaller after being heated "cherry-red" and cooled. There is every reason to believe that much lower ranges of temperature will alter the form and dimensions of metal, which changes can be recognized only if we have sufficiently delicate means of measuring them, as we have in the case of a cylindrical gauge and its ring. In other words, the ordinary atmospheric changes of temperature affected the form of the ring or the dimensions of the plug, but to so small an extent that it could not be detected by any ordinary means of measurement. The great accuracy with which they were made to fit each other gave the means of discerning the change.—*The Railroad and Engineering Journal.*

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Mr. F. S. Pecke, a civil engineer,of Watertown, N. Y., lately accomplished in a very simple and expeditious way what is usually a difficult and expensive operation—the laying of a long line of pipe in deep water. He had occasion to lay nearly a thousand feet of suction pipe at Rouse's Point. The water was needed for manufacturing purposes, and,as it was found that near the shore it was more or less oily and impure, it was necessary to have the inlet a considerable distance out into the lake. He purchased a steel pipe of 8 inches diameter, manufactured by the Spiral Weld Tube Company, at East Orange, N. J., and used for couplings, cast-iron flanges, weighing, with bolts and gaskets, about 65 pounds to the pair. Plugging the end of the first length, he pushed it out on the surface of Lake Champlain and connected the second length, pushing this out in turn, until the whole line was coupled. It then presented the unusual spectacle of a line of 8 inch pipe nearly a thousand feet long, floating with a displacement of only $3\frac{1}{2}$ inches of its diameter. When the requisite length had been connected, the line was towed to position, the plug at the end removed, and the pipe sank easily in $16\frac{1}{2}$ feet of water, without breaking a joint or receiving an injury. No buoys or floats were used in the operation, and no apparatus of any kind. The pipe is now in use as the suction of a steam pump and gives perfect satisfaction. Work of this kind usually involves the use of expensive and troublesome flexible joints, and Mr. Pecke's ingenious expedient is worthy of record.

This is all right if the bottom is level.

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The Indianapolis *Journal* says that "there is an unusual exodus of men, in all departments from the railroad service at the present time. The reason assigned is the uncertainty of positions in the railroad service. In most cases the men going into other business are among the best in the employ of the roads. Such men watch for a business opening, and, when it is offered, take it without much parleying.

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The hand that rocks the cradle moves the world, says the poet, and it certainly seems so at times, from the noise evoked.

TRADE NOTES.

In St. Louis it is claimed that the replacing of horse cars by electrically-propelled cars results in a saving of at least 40 per cent.

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Ray Gaul, late assistant United States boiler inspector, has been appointed superintending engineer of the Union Ferry Company, of this port.

* * *

The Anglo-American Gas Lighting Company has been organized to light both hemispheres, Eastern and Western, with a capital of $50,000,000.

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Flash signals, by means of the heliograph (mirror), are used for communicating between stations in New Mexico and Arizona seventy-five miles apart.

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George Peterson, chief engineer of the steamer *Syracuse*' and a well-known North River man, died of pneumonia at his home in Albany recently.

* * *

An immense hydraulic riveter—the largest ever made—has just been built in London, for a company n Holland, to be employed on marine boilers. The riveter has a gap 12 feet deep, exerts a power of 200 ons. and is capable of closing rivets up to 3½ inches n diameter.

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The conditions of the supplementary horse-power rial of the dynamite cruiser '*Vesuvius*' have finally been determined upon, and the trial will take place n about two weeks. The vessel will be run five knots over a straight course, and will be required to average 3,200 h.p. for the run.

* * *

The Pond Tool and Machine Company, of Plainfield, N. J., has been awarded a Government contract to build ten lathes, which are to be used in making the monster guns near Troy. Each lathe will cost $25,000, and three years' time will be required to complete the contract.

* * *

Captain George P. McKay, Secretary of the Vessel Owners' Association, Cleveland, O., has in his possession a letter containing the pilot papers of John N. Stewart and the engineer papers of Allan Bulley. Their addresses are unknown, and their papers will be returned to them on application.

* * *

James R. Sheffield, of the New York and Northern Railway Company, has contracted with the Newport News Shipbuilding Company, for a ninety foot steel propeller to be fitted with Horace See's quadruple-expansion engine, which will be the first of this kind ever built in the United States.—*Marine Journal.*

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The Strong Locomotive Company has completed arrangements for the erection of very extensive ocomotive building works near Cincinnati, and expects in the course of a year to have in operation model shops, supplied with the latest machinery and ools, building not only locomotives of the "Strong" variety, but those of the ordinary construction.

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In the new hotel at Tampa, Fla., the electric ights in the sleeping apartments will be so arranged hat they may be made to burn with any degree of brilliancy by turning on or off in the same way as a gas jet or kerosene lamp is regulated. This will overcome the greatest objection to electric lights in bedrooms, which by all former appliances give their full capacity when used.

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A company has been formed in Hartford to build a dam across the Farmington River at Tariffville, put in dynamos, etc., and generate electricity which s to be conveyed by large copper rods, strung above ground to Hartford, eleven miles away. About 2,000 h.p will be turned into electrical energy. The Hartford Electric Light Company has agreed to use a portion of this energy, enough, in fact, to supply ts patrons and light the streets. The surplus power will be used for electric motors in factories and elsewhere.

* * *

The steamship '*Algonquin*,' of Glasgow, Scotland, ,805.61 gross tons, built 1888, at Yoker, Scotland, and employed in the carriage of freight on the Great Lakes, was disabled on the 10th of August by the partial collapsing of the furnaces, of which there were six, of the Brown pattern. Six new furnaces of Cox's corrugated pattern, specially manufactured by the Continental Iron Works, Brooklyn, N. Y., were put in, and the vessel commenced running again on the 14th of October.

* * *

Sir Joseph Whitworth & Co. propose an important departure from present practice in marine and other boilers. At the Manchester Exhibition the above firm exhibited a weldless boiler ring, 12 feet diameter by 6 feet long, which attracted considerable attention; and it is their intention to lay down plant for the construction of boilers built up of weldless rings, for which it is claimed that while they reduce the weight of the boiler by 30 per cent., it is kept up to its full strength.

The suggestion is not by any means new and has been done already, but on a small scale only.

A company has been formed with a large capital to establish a plant in New Bedford, Mass., for building iron and steel sailing and steam ships. The proposed vessels are to be of large carrying capacity, fitted with all the modern improvements. They will be specially adapted to carry American products to all parts of the world at a low rate of freight. This company is ready to begin operations as soon as the Farquhar subsidy bill for American ships becomes a law.

We very much fear that none of the present generation will live to see this shipyard, under the circumstances.

* * *

J. C. Sterling, of the Illinois Steel Company, employing about 2,000 men, addressed the employes, recently, submitting this proposition to them : The company will give each man who stays one year 1 per cent. of his wages, and so on up to five years, when 5 per cent. of his wages will be added to his pay, thus, at the end of five years, the company will be giving these employes $60,000 a year. Men entering the company's employ July 1, 1889, are entitled to the benefit. The men received the proposition with unbounded joy. This will settle all likelihood of strikes or quitting of work without giving notice.

* * *

Storage batteries are coming into vogue for use in conjunction with incandescent lighting plants. Several central stations, after two years' experience of the combination, speak of it in terms of unqualified praise. An expert says: "I have learned to look upon the storage battery as an able lieutenant to the incandescent dynamo, and to put in a good word for it wherever I go. I find that although a good many people do not care to introduce the storage system all at once, they quickly see the advantage of having the current on tap at all hours and yet only run their steam plant in the evening. The use of secondary batteries for lighting purposes may eventually develop to an extent we have now no conception of."

* * *

Edison has not only invented a phonographic doll, which produces a great many wonderful speeches and songs, but he suggests, and through assistants, is already working upon phonographic canary-birds which are expected to render the sweetest notes of that favorite little singer; artificial parrots which can be made to sing, whistle, talk and do more than any actual parrot ever could. Dogs, horses, cats, geese, ducks and chickens will produce every sound which can be produced by the real live ones. The phonograph will soon be able to do a vast deal of work which now taxes the human throats and lungs, and really seems to be but in the infancy of a career of usefulness and wonder.

If Edison makes anything that whistles, a tortured people will rise up and suppress him.

* * *

Bennett C. Wilson, whose suit against John W. Keely two years ago led to the latter's imprisonment, but resulted to no advantage to Mr. Wilson, claims that all of Keely's discoveries belong to him under an old assignment, and he proposes to sell the secret of the wonderful motor to whoever will offer him the highest price for it, but he does not guarantee that it will accomplish all that has been claimed for it. "I want to give the secret to the world, because I believe that Keely will never be able to advance any further with it," Wilson said. "He is no further along now than he was twenty years ago. I believe that he honestly desires to produce a commercial engine, but he is unable to do so, and the secret ought now to be given to the world, so that scientific men may endeavor to perfect the discovery."

Bosh !

* * *

Business is booming in the steam launch line. Down at the foot of Fifty-sixth Street, Brooklyn, Builder Ofeldt, the inventor of the Ofeldt launch, has six nearly ready, and orders for many more. One for the Crescent Athletic Club, 40 feet long and 8 feet beam, will be launched in a few days. She is called the '*Crescent*,' and she will run between Bay Ridge and the clubhouse. A 35-foot launch for the London Pacific Oil Company of Peru is almost completed. She is 16 h.p. A 40-foot launch for Dr. McCort is also under way. She has 8 feet beam, and a fine cabin. She is 16 h.p. and is to be used as a towboat. One for Robert Goelet is 20 h.p. with a handsome cabin. She is 40 feet over all and 8 feet beam. A 35-foot, 16 h.p., cabin boat for Lake Hopatcong is almost completed for Albert Tilt.

◆

An advertising canvasser went into an old-established house and asked for an order. The principal told him they did not advertise; they were so well known they did not need it. Everybody knew them.

"Will you be good enough to tell me the name of the candidate for Vice-President of the United States eight years ago," said the agent. The merchant said he did not recall it at the time. "Do you know of anyone who was better advertised all over the country?" said the agent. The merchant reflected and seemed to get an idea into his head.

Did you ever go back to the shop where you served your time after an absence of thirty years or so ? If you have not, do not go, for you will be a stranger in the gates. You will not see a face that you know. Another man is running the lathe you ran, another man is at your vice. He is younger than you are, and he does not know you. No one knows you, and no hands are stretched out, no cheerful greetings salute you. Your day and your generation have passed away, and you are no longer needed in that shop. You are as virtually dead to it as if you had long since mouldered into dust.

◆

Of a new compound locomotive recently built, a contemporary says:

> "The economy in actual practice, while not exactly actual, so far, has been so apparent that in the tests which are to be undertaken, the company expects a saving of at least 25 per cent."

We do not know what this means. A locomotive that has no actual economy, but of which 25 per cent. is expected, seems to be a very curious one to us.

◆

The '*Normannia*' is the latest steamer constructed for the Atlantic passenger traffic. She is a twin screw ship, 8,500 tons burthen, and has engines of the triple-expansion type, cylinders 40 inches, 67 inches and 106 inches in diameter respectively, with a stroke of 5 feet 6 inches. On the measured mile she made 21 knots.

◆

The '*Cushing*,' U. S. N., torpedo boat, recently made 19½ knots for six hours between this city and Newport, against wind and sea.

◆

The Manual of Screw Cutting is out of print ; do not send for it.

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In former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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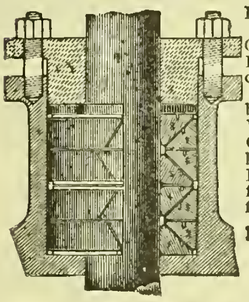

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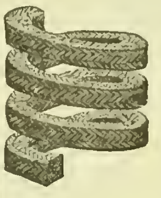

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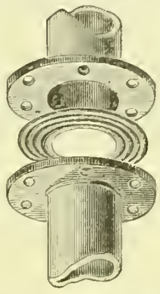

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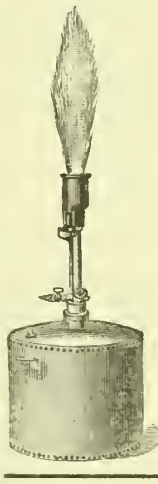

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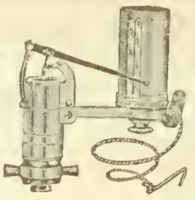

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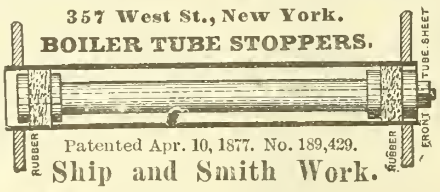

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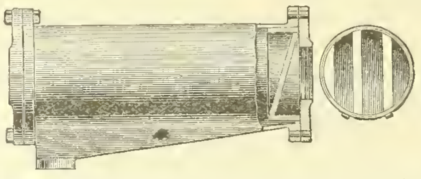

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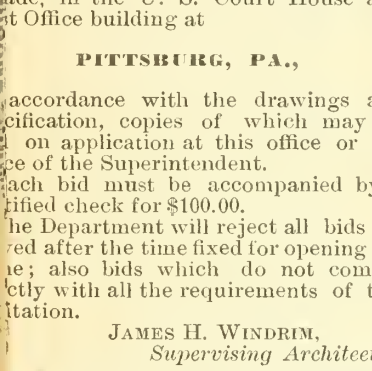

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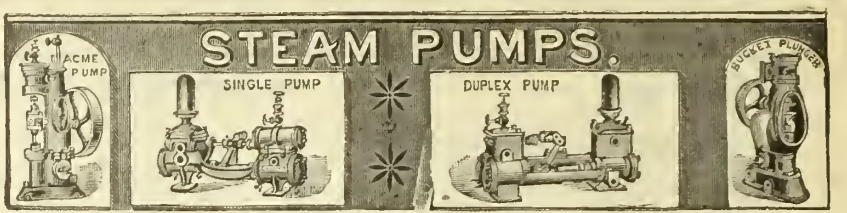

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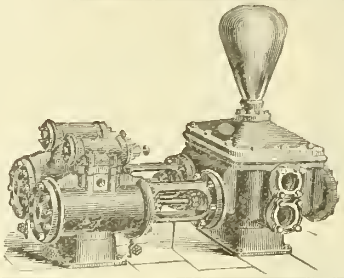

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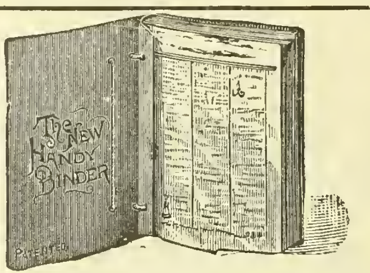

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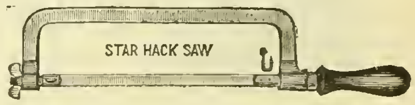

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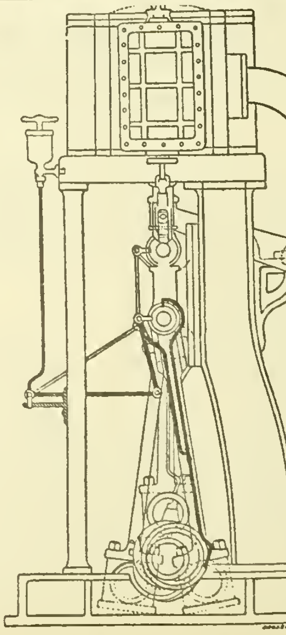

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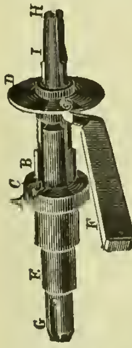

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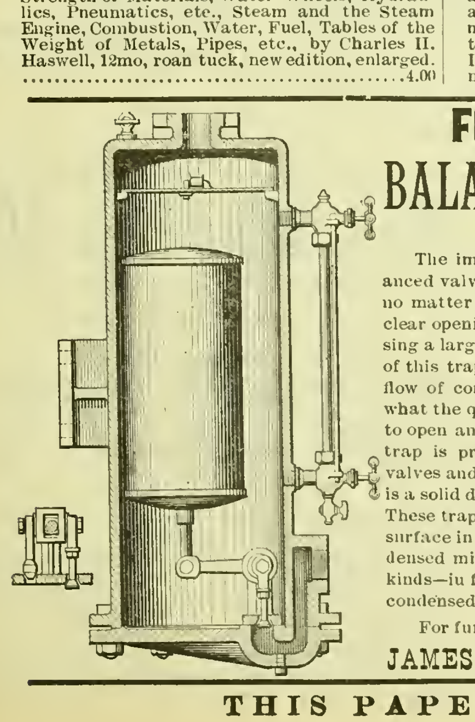

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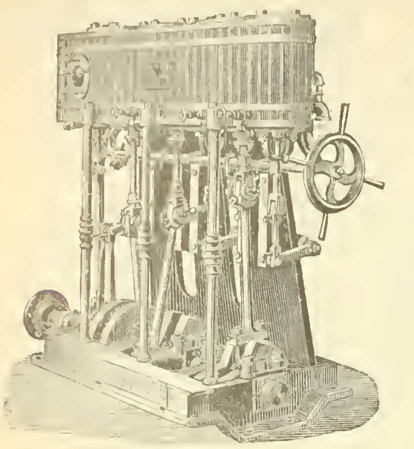

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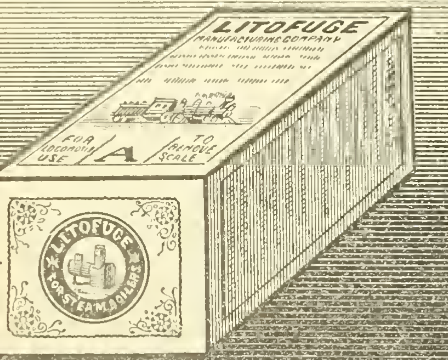

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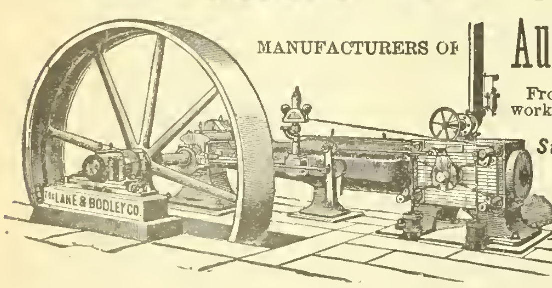

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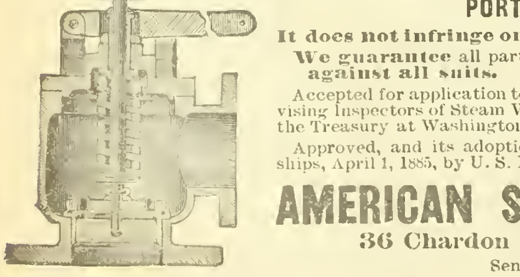

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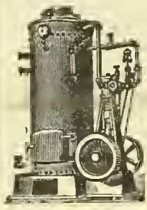

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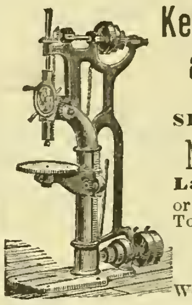

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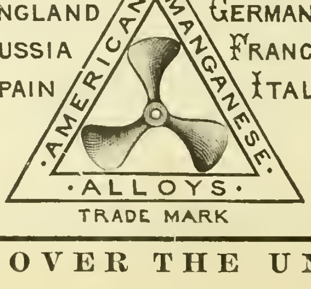

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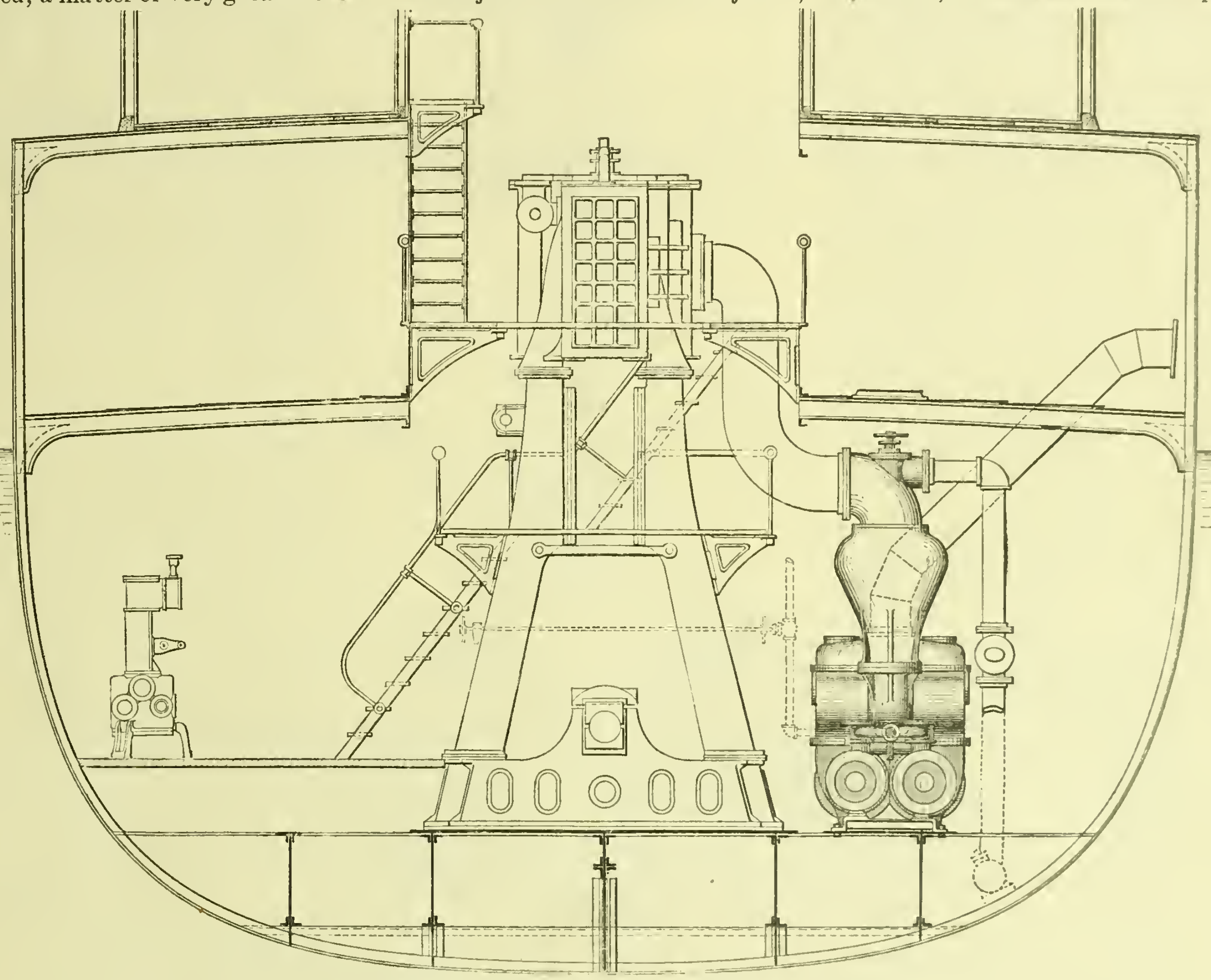

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OUR CENSUS OF MANUFACTURES.

On the second day of June the work of collecting statistics of manufactures for the report of the Eleventh Census will be inaugurated throughout the entire country. The value of this report must depend wholly upon the accuracy and thoroughness with which manufacturers answer the questions propounded.

The personal interests of every manufacturer are involved in the character of the report on manufactures. It will be quoted for the next ten years as the official announcement of the *exact* industrial condition of the country, and will be the basis for any future legislation that may be enacted in regard to the wants of our people, whether engaged in agricultural or mechanical pursuits. Therefore it is of vital importance to each manufacturer that an accurate report shall be made.

The Superintendent of Census has taken every possible precaution in the preliminary work to make this census complete and satisfactory, and the earnest co-operation of those engaged in productive industry is all that is now necessary to secure valuable results.

Every manufacturer should bear in mind that his answers to the questions relating to his business are held strictly confidential, are not disclosed to any competitor or to other persons, and are not used by the Government as predicate for the purposes of taxation or license, or in any way to adversely affect his individual business. This assurance is printed on each schedule over the signature of the Superintendent of Census.

The expert Special Agent in charge of this branch of census work, Mr. Frank R. Williams, has personally visited the principal manufacturing centers and consulted representative manufacturers, the publishers of trade journals, and practical business men generally, for the purpose of ascertaining the proper scope of the inquiry for each branch of manufacture. The questions contained in the census schedules are those suggested by the manufacturers and other persons most interested in the progress of the country, and cover ground absolutely essential to the proper presentation of its industrial conditions and resources.

◆

At the close of the Crystal Palace Technical School in England Prof. Elger told the graduates some wholesome truths, to wit:

"It is the power to apply knowledge to various circumstances as they occur, and to overcome difficulties that are not dealt with in text books, that goes chiefly towards the making of a good engineer. Scientific and practical knowledge are both absolutely necessary, and the extent of such knowledge is tested to a great extent, not completely, by your examinations; but your future success will depend mainly upon the manner in which you are able to use and apply your knowledge in the work upon which you may be engaged, and upon the power you acquire of solving new problems, and of overcoming difficulties for yourselves as occasion may require. Character, tact, and other personal qualities, are of equal importance to technical knowledge and skill, and are equally essential to success, as is also that subtle power which is present in some, and is deficient in others, of convincing and controlling men. George Stephenson used to say that he could always engineer materials, but he could not always engineer men. In conclusion, I would remind you that the engineer requires above all that saving quality which has been eulogized by one of our poets in these words:

"Good sense, which only is the gift of heaven,
And though no science, worthy all the seven."

◆

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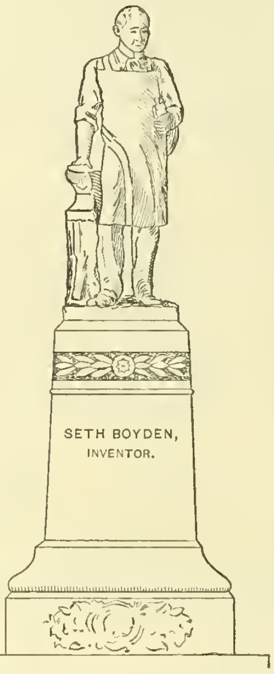
The first bronze statue ever erected in this country to an American engineer is that of Seth Boyden, which was recently dedicated in Newark, N. J. It was designed by Karl Gerhardt, of New Haven, and cast in this city by Henry Bernard. It cost $7,500, and the raising of the money can be justly attributed to the personal exertions of ex-Chancellor Runyon, who in 1886 started a new movement, when all others had failed, and enlisted the aid of prominent and wealthy men. The Seth Boyden Association finally turned its funds over to the Board of Trade, and that body carried the project on. It represents him as he was best known, with his shirt sleeves rolled up, his head bare, and his working apron hanging below his knees. It represents Seth Boyden in all except the features, which, in the hard bronze, were scarcely as rugged as they were in the flesh. The bronze figure, nearly nine feet tall, stands on a granite base ten feet in height. The right hand rests on an anvil, against which a heavy hammer leans, and in the left hand is a small model of a locomotive, toward which his eyes are bent. On the granite base is the simple inscription: "Seth Boyden, Inventor." There is not another word on the structure.



Ex-Chancellor Theodore Runyon delivered the oration, reviewing Boyden's life and works, and giving him full credit for the invention of malleable iron, the perfection of enamelled leather in this country, the introduction of straight axles and connecting rods on locomotives, the cultivation of the perfect strawberry, his researches in electricity, photography, and metallurgy, as well as his voluntary assistance to Prof. Morse in the perfection of telegraphy, and his many fruitful researches in the sciences. He spoke of his unselfish devotion to his works for the benefit of humanity, and his lack of acquisitiveness. He referred to Seth Boyden as the inventor of reversing gear or "link motion," as used to-day on engines, and credited him also with the invention of the duplex valve gear for pumps.

Seth Boyden was born in Foxborough, Mass., on Nov. 17, 1788, and came to Newark in 1815, when he was twenty-seven years old. He came of Revolutionary stock. He had no trade, but was brought up on a farm and did agricultural work only, except as he occasionally assisted in the work in a furnace, employments which could have given him no practice or instruction at all to do fine or minute mechanical work; yet without any instruction he repaired watches, and that, too, when he was but fifteen years of age. He made a telescope of great power, doing much of the work upon it with his own hands. He made his own electrical apparatus. He made for his own use a rifle with a lock of peculiar and ingenious construction, and he made also an air gun. He made a microscope of great power. He painted a miniature of himself on ivory when he was but eighteen years of age. It is a very creditable production. He engraved a label for his books, and he engraved also a portrait of Washington, both on steel. The label shows the bent of his mind. Its ornamentation consists of the representation of a shelf of books, a retort, a collection of jars of chemicals, a barometer and a thermometer, and an electrical machine. He made a watch case of oroide with only a hammer and a small foot lathe for tools, and this he did when he was over eighty years of age. When one of his eyes was affected by some malady, and physicians were in vain, he undertook to treat the disease himself, and to that end constructed an instrument of great magnifying power, by which, with the aid of a mirror, he could, with the eye which was unaffected, look into and examine the condition of the other.—*N. Y. Sun.*

◆

THE 'PHILADELPHIA,' U. S. N., CRUISER.

From all accounts the '*Philadelphia*' is a splendid vessel, and will prove a great acquisition to the new navy. The hull is essentially the same as the '*Baltimore*' in model and dimensions, but the engines are quite different, being of "American design" in detail throughout; in dimensions they are quite as efficient, if not of higher efficiency, than the English engines in the '*Baltimore*. These last are $42'' + 60'' + 94'' \times 42''$, while the '*Philadelphia's*' engines are $38'' + 58'' + 86'' \times 40$. The '*Baltimore*' uses steam at 135 lbs., while the '*Philadelphia*' uses steam at 160 lbs. The '*Baltimore*' has enormous slide valves worked by link motion, while the '*Philadelphia*' has piston valves worked by an improved Marshall gear. On the trial trip the '*Baltimore*' made, in a four hour run, 20.1 knots as the highest speed. On a 32 hour run, eight times longer in duration than the '*Baltimore*,' the '*Philadelphia*' made 20.74 knots. The revolutions were: for the former, 116.8, and for the latter 118.

The trial was in every way a success. The engines were run at a high rate of speed, for a long period, and there was no heating or trouble of any kind. No difficulty was experienced in keeping up steam, and there were no hitches to mar the success of the trial.

The builders of the '*Philadelphia*' are confident that she will prove as fast, if *not faster*, than her sister, the '*Baltimore*,' and earn them a handsome premium. Under the contract, the '*Philadelphia's*' horsepower is not to enter into the requirements of the test, she being required to make nineteen knots an hour, all over that gaining for her builders a premium. Her engines were designed by Horace See, formerly superintendent engineer for the builders, but now of this city, and great power and speed, it is expected, will be developed by them.

◆

According to Mr. Froude, the screw of a vessel of 500 indicated horse-power, and 10 knots speed per hour, might be 10 ft. in diameter, 0.8 pitch ratio, and run at 138 revolutions per minute; or it might be 15½ ft. in diameter, 2.5 pitch ratio, and run at 33½ revolutions. Both screws would be credited with an efficiency of 69 per cent.; but the large screw was at a disadvantage when placed in a following stream, on account of the greater difference in the velocity of wake currents which it experienced, and also because of its greater liability to emerge from the water. To maintain a high speed against head winds and sea, a relatively large screw was desirable; the case was analogous to that of a tug. For such a purpose increased diameter should not be associated with increased pitch ratio. The propeller of 15½ ft. diameter and 2.5 pitch ratio would probably waste as much power when working against head seas as the 10 ft. propeller of 0.8 pitch ratio.

◆

Axminster carpets are made in England which cost $25 a square yard. The pile is an inch and one half deep.

NOT TOO OLD TO LEARN.

I USED to think I knew all about lap and lead but when I saw a man get on the pilot and hook on his jim cracks, and take "steam picters" and then pull open her valve chests and chip and file and then set the valves by his "jim crack picter" again and never look at the slides or cranks and when he said it was right—and told the superintendent of M. P. to climb in the cab and let her go and "she went"—I just made up my mind that lap and lead were gone—and I didn't believe my own ears when "she barked" squarer'n a pressed brick. But when the fireman begun to ask me "what in thunder we were doing on the front end?" and he had to fire with about four inches less lap on his shovel, I opened her up and soon found we could make more time than general orders allowed and the superintendent of M. P. was puttin' down figgers, and countin' mile posts until I begun to think "your old uncle was out'n a job" and then when we were on the home run, the jim crack man sat down on the right hand side to see how she barked, and watched the water and steam, and said nothing except, "lay her up" I got dizzy, and now I don't know nothin', but I can run on less coal than ever, and though I don't know much about steam picters, I'm always glad to see my friend of the "jim crack" forerd end business, and I'm glad to "haul him" but I can't figger out lap and lead, and my fireman swears that he can run on four quarts of ashes and two pans of coal.

I'm old enough to know something, and I have learned that running an engine with lap and lead played out several years ago on some roads, and I've learned that every man who lugs 'round a box of indicators can't handle an engine to the engineer's benefit, any more than every man can play doctor—and what I do know w'uld make a small book with but few leaves in it—and what I don't know, and am pretty sure of (that I don't) w'uld want about six full unabridged dictionaries, and I ain't certain six would be enough to hold what I'm sure that I don't know, but I am certain that an old band can learn something most every day if he don't get the "know it all" so his neck is stiff, and I'm in for learning something once a day, and I sometimes think I'm an "old fool"—certain anyhow that I can't be a young one again very well, and there's a lot I want to know yet.—*Uncle Silas, in Loco. Fireman's Magazine.*

◆

MEN without political ambition look with amazement at the spectacle of other men spending large amounts of money, working early and late, neglecting their regular businesses in order to obtain some fleeting, empty, civic honor. Who and what is the politician of ten years ago? If he is not in exile from the consequence of his own acts he is a mere nobody, of as little importance to the world at large as a car horse.

"It is a mad world, my masters!"

◆

A GENTLEMAN in Australia, thinking he had a valuable coal mine on his property, took a specimen of it to a coal sharp, who, after cautiously examining the barrow-load of sodden earth, asked: "Got much of this?" "A mountain of it and more, sir!" "And is it all like this?" "Yes; from base to pinnacle." "Are you a pious man?" "Yes." "Believe in an early destruction of the world by fire?" "Yes." "Well, when that comes about, you get on that mountain and sit there, and you'll be the last man!"

◆

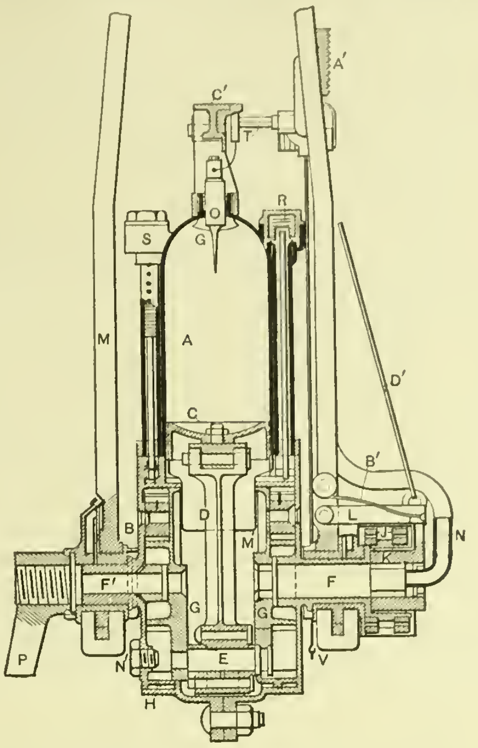
YOU have doubtless seen the cleft-shank button-headed fastener used for holding documents in place; this fastener has very wide uses, and is made by the ton. It is patented, and the inventor, if he was smart, should have made a pretty penny out of it.

◆

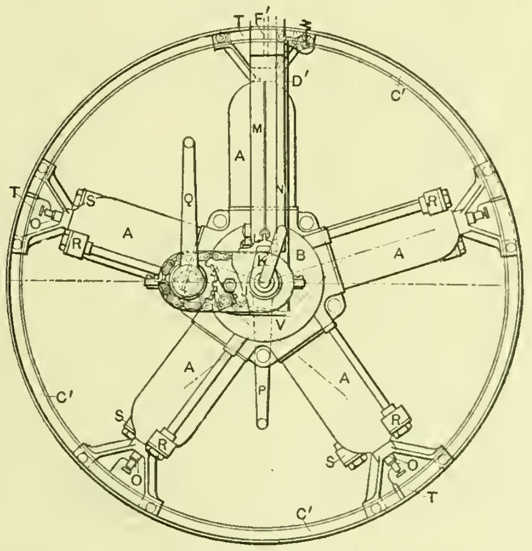
DON'T express a positive opinion unless you perfectly understand what you are talking about. Even then go a little slow.

NOVEL STEAM ENGINES.

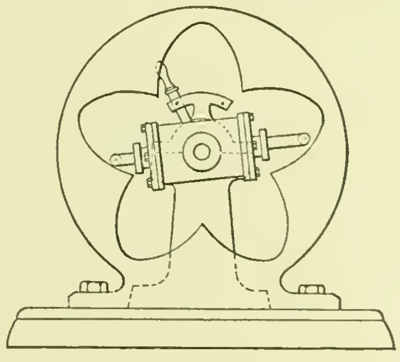
THE engravings represent two forms of engines recently patented abroad, which display a certain amount of ingenuity in design as regards attaining the ends of the inventors. We hope no one will feel that we think that they fill "a long-felt want" The first is a rotating cylinder engine, not new in type, of course, but new in that it has a different arrangement of crank from that generally adopted in such engines.



This particular engine is intended for gas, and has a great quantity of trappy gear about it which could be dispensed with for steam and be far more efficient. Our object in presenting it is to show the general design. The other illustration shows a rotating cylinder engine also.



The engine has one or more cylinders fixed to the shaft so that their axes are at right angles to the axis of the shaft. The piston rod of each cylinder protrudes through the cylinder's ends, and the piston is secured to the center of the rod. The ends of the piston-rod carry small rollers, which work against the surface of a continuous cam, and cause the cylinders and the shaft to revolve. The cylinder is mounted by the trunnions or shafts, upon the brackets secured to the base plate. Its piston-rod carries the rollers. The cam may have any odd number of projecting surfaces; the number must be odd, so that during the time one end of the piston-rod descends the incline of one projection, the other end ascends the incline of the other. By this means the cylinder is caused to revolve about the axis of its trunnions, or, on the other hand, if the cylinder be fixed and the cam free, the cam will revolve. The trunnions of the engine are hollow, and the motive fluid supplied through one and exhausted through the other.



◆

DANGERS FROM GAS IN STEAM BOILERS.

PERIODICALLY someone who has not read what has been said and done by able observers of the phenomena of boiler explosions revives the theory that the violence of them is due to the presence of gases in the steam space, which are, in some mysterious way which the proponent does not attempt to explain, exploded with destructive effect. It is not necessary to take any trouble to propound or to refute this theory, which is as old as the steam boiler itself almost, for it is perfectly plain that no gases except the original constituents of the water can be found inside of a steam boiler. Also, that these gases can only be liberated by the destructive distillation of the water itself, which occurs only at a red heat. Supposing, now, that a crown sheet or tubes supply this red heat, there must then be admitted to the gases certain volumes of atmospheric air, which volumes of gas and air must be intimately mixed before ignition of them is possible. To this mixture live fire, either a flame or an electric spark, must be introduced before it can be exploded. This is an operation so complicated that, it is needless to say, it is not even a plausible explanation of the cause of boiler explosions. In fact no theory is needed, for the teriffic energy of heated water and steam, when suddenly released, is explanation enough.

Gas is, however, the cause of many accidents to steam boilers, but it is not in the steam space but in the furnaces and smokeboxes that it does its work. It may arise through banked fires and closed dampers, or it may come from water-gas, made from steam in highly heated smoke boxes, where there is no sufficient exit by reason of a partially closed damper. Suppose that a rivet head or a seam leaks below the water line, or above it for that matter, and the temperature is very high, as it frequently is. It is possible to decompose the steam into the original gases and with more or less air coming in through the flues to maintain combustion, create an explosive mixture. which the first flame entering the smoke box or combustion chamber will ignite. This process is also a complicated one, but there is reason to believe that it has occurred in many cases.

◆

THE various inventions of the past few years—rapid fire guns, high explosives, torpedoes, submarine boats, dynamite guns and range-finders, the increased power and perfection of steam and electric machinery, the improvements in powder and in steel for projectiles and for armor—have not revolutionized naval science so much as they have broadened it. The principles of strategy remain the same and so does the necessity for the seaman's skill. Engineers construct, inventors invent, experiments are tried, sham battles are fought, and heated discussions agitate the naval mind, but the only thing that can determine the real conditions of modern naval warfare is a modern naval war.—*The Forum.*

◆

IT strikes us as singular to see an advertisement in an American paper from a firm in England, offering an American machinist a job at $10.50, for a first-class lathe hand, when the same man can get $15 to $18 here.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

THE LOG OF THE 'BUTTERCUP' STEAM LAUNCH.

WRITTEN UP BY THE LADY CHIEF ENGINEER.

Editors ENGINEER:

You see I remember your invitation in a former issue, to "favor us again with a further installment of your experiences." Well, my spring shopping is done, bonnets, dresses, and wraps purchased, and I am beginning to tramp about the town for health, entertainment and instruction. I'm a great believer in "out-door air," and I believe in tramping and I retain good health thereby. There is much to learn, too, when one goes about seeking information. I follow Charles Reade's advice, and cultivate "attention, observation, accuracy," and I now and then make a note for future consideration. All young men should do this. Especially young engineers—they'll get ideas—they'll lay up a store of useful facts unattainable otherwise. I read now and then, in your paper, letters from young men who desire information how to start out in life. I would like to say to such that they should *think, think, think!* use their intellect—the greatest force God has given them—and, really now, it is so little used! I see engineers afloat and ashore, who work for their pay only; thoughtless fellows when they have so much time to think, study, and improve their knowledge of the noble profession in which they are engaged, giving no thought to anything save routine. I pity such, for I know what they miss in life. I often interview them and generally prescribe a good dose of one year's subscription to THE ENGINEER—and other professional literature. One told me he had no time to read, he was "taking dancing lessons." "Well, that is all right," I said, "but get the paper and look at the pictures, and you will soon begin to read and find you have ample time to do so." I was once talking with a locomotive engineer employed on the Fitchburg Railroad. Said I:

"Do you get plenty of steam out of that boiler?"

"Oh, yes, when she is fired right," he replied.

"How much coal do you burn on your daily trip?" I inquired.

"Well I don't know as I ever noticed" was the answer.

Now this man was fine looking, intelligent, and about twenty-eight or thirty years of age, and I said to myself, "I bet he is a fair sample of the average engineer on railroads, and I think I will question him further," so I said:

"Do you mind, sir, if I ask a few questions for personal information?" He did not mind, so I proceeded as follows:

"If you will tell me the size of your grate I believe I can estimate somewhere near the amount of coal you burn, on an average.

He did not know.

"Then tell me what cut-off your valve is set to, and the heating surface in your boiler."

"Didn't know, boss mechanic in the shop looked after the valve."

"Have you ever ascertained the square feet of heating surface in your fire box?"

"No."

"What's your estimated tractive force?"

"Well, I really don't know."

"Never considered it yourself?"

"No."

His repeated "no's" somewhat embarrassed me and I stopped my quizzing, after hearing that he never had much time to read books on engineering, nor did he take enough interest in the railroad company to work for its interest in saving coal, or in looking after the welfare of his engine; he simply worked and killed time for the small salary he received. The small salary made him a small engineer. Now, I say, I pity such engineers; they injure their own interests and then growl loudly when some thinking man is promoted over them.

The same criticisms apply to some marine men: let them use their brains more in study, open up the throttle of the intellect and think, think, think! $X+Y$ will soon have a familiar appearance if they will think and study over it, and then their excellent practice will be an able assistant in the theory. Then they'll brace up a little and have more self-respect. No engineer has self-respect who neglects to do his best, no matter if he be underpaid. I like engineers; they are brainy men, and I have no patience with those who sneer at theory, or allow themselves to feel that as they "never got much education," they are therefore debarred from golden opportunities in the future. It's knowledge that tells, not "brains" The public is ready to give all the respect that is due to the noble profession of engineering. Let engineers respect their calling and do all they can to perfect themselves in it and credit will be given where credit is due, and long overdue, too. The narrow minded assertion "I do what I'm paid to do," is death to advancement. Let the engineer improve his status, be honest, and a credit to himself and some one else will want him. He is a valuable man, and his employer will be willing to pay him more if the position warrants it. It is self-respect, honesty, faithfulness, character, knowledge and skill that promotes men. Let the young engineer perfect his knowledge of the business if he wants to advance, to get more pay. Let him go to work on books, read and re-read them. The more I read the more fascinating the subject grows. I see much in books that I do not understand, but it makes no difference; I keep on, and somehow or other I do learn a thing or two, and eventually understand quite easily what once seemed incomprehensible. I talk, sometimes, with the big men in the profession, it keeps me from getting conceited. I find they study hard. What better example? But, Messrs. Editors, I started to write my experiences. Cut out the above if you think best to do so. [By no means.—EDS.]

Now listen: The "jingler" says, "go ahead at full speed." 'Twas aboard the '*Buttercup*' about nine o'clock A. M., on one of those calm, warm mornings in midsummer, when mere existence is heavenly, not a zephyr disturbed the mirror-like surface of the noble Kennebec, "the river of dark flowing waters," as its Indian name implies. That violin of the shipyard, the caulker's mallet, made music on every side. 'Twas dead low water. The delicious salty odor of the sea mingled now and then with the pungent scent of pine and cedar, greeted our nostrils like wild incense. The tide was beginning to "soak up" river; steam was up; our awning was spread, carpets stretched, cushions arranged, stores aboard, as off we went, all in good order, colors flying, bound for Augusta, thirty-two miles up river. The river on which is stored, at the present writing, nearly two million tons of ice, and all sold, too, for some ten million dollars.

Our party this day consisted of my own family, Miss S. and Mr. M. of Boston, Miss S. and lady friend of Bath; seven of us, ship's company all told. How we did skip along up the beautiful river, seeing new beauties on every side! How joyous every heart! all cares laid aside, with no thought of danger to disturb the perfect peace of the surroundings.

As I look back I think I was never happier than on that very morning. I had arranged my party to suit each person's convenience. They were all forward, my son at the wheel, his high-speed tongue running as usual under full pressure; he kept the party in a roar of laughter whenever his wit flashed, Now and then our Captain would call, "steady there!" and my son would let up for a moment. I was seated aft on the port side of the engine contemplating the beauties of the surroundings and meditating on the power of steam, the rapid and noiseless running of the little engine; and now and then I would seize the oiler and put a few drops of oil here and there when needed. Everything about our little ship was in perfect condition; even the brass work was highly polished—thanks to my son.

Our Captain, meanwhile, was in a most comfortable position, smoking and occasionally feeding the fire. He sat opposite me on the starboard side; quiet seemed to reign. I remember he turned to me and said, "Ah, dear wife! this is indeed blissful; as Poe says in the *Oval Portrait*, 'this is life.'" I did not reply, for I was at that instant frightened nearly out of my senses by an explosion. What was it? what had happened? I was enveloped in steam so dense that I could hardly see six inches from my face. My first thought was, the boiler has exploded. My second, no, it was about to do so. My third, what is it? and what has become of my husband? Meanwhile the hiss of escaping steam continued, and I could feel the sting of the hot drops of water occasionally on my face and hands. I noticed the engine was still running, and beyond the hissing, dead quiet reigned. I probably realized all this in five seconds of time; then I heard my husband say: "don't be alarmed, it is only the water-glass that has broken." He was then closing the cocks, when the steam and water being shut off, the air became clear again, and as I looked forward I saw my son at the extreme end of the bow, his hair *en Pompadour* in reality, ready to go overboard at a moment's warning, while the frightened, inquiring countenances of our friends were turned towards us. Explanations soon quieted all fears, and we soon had a new glass in place, which we covered the next day with a brass wire mesh to protect our faces should the glass burst again. [Can you see through it?—EDS.]

A trifling incident like this is of no account to one experienced, but to us greenhorns it amounted to a great deal. It is not pleasant to receive such a scare for the first time. Not being acquainted with machinery, and knowing that my husband was new to the business, I was always ready for the unexpected; my nerves were always strung up, so when anything unusual occurred it was always startling. However, in this case affairs soon regained their wonted composure aboard. I had passed forward, and Mr. M. had gone aft, where he was conversing with my husband on accidents and steam engineering in general. I remember that I heard him say:

"What safe-guard have you against explosion of the boiler?" and my husband's reply:

"The safety valve, which you see is on top of the boiler; when steam is up to 130 lbs., it presses hard on the spring which is in the valve-casing, and a certain amount of steam escapes; just enough to prevent the pressure going beyond 130 lbs. I generally run it 125 lbs. You see the safety-valve has a small lever on the side to which a wire is attached. I will now pull the wire and show you how the steam escapes. See!"

All this I heard from my seat forward. I heard the steam escaping from the valve and wondered why it did not stop. I saw something was going wrong, for my husband was doing something which I could not see. The steam continued to blow, and floods of muddy, greasy water, poured down over the smoke bonnet, while the boat's speed was lessening perceptibly. I instantly realized that all the water in our little boiler would soon be blown off, and cast my eyes towards each shore to see which was the nearest, in case I concluded to swim for it. At the thought of being blown there in a thousand pieces, I could hardly restrain myself from going overboard. Were we to be blown up at last—after all? If so, I concluded I would stick closely to my husband, and passed aft where he was working. My first glance fell on the water-glass. Gracious heavens! no water there. I tried the guage-cocks—nothing but steam appeared. Meanwhile, the inspirator was doing its work, thank goodness, and finally the safety-valve closed after blowing out a lot of greasy, muddy water. This was scare number two, to two of us. We did not say much about it to our friends forward, who thought all but the flood of water was an ordinary occurrence. They were unconcerned, and hardly noticed what was going on.

My son was wiser. He interviewed his father, and said in an emphatic manner that "this was his last trip, he didn't care to risk his life again" and, "if we wanted a pilot we must get another boy." My husband, somewhat annoyed, said:

"Young man! the first thing you must learn is to obey orders when aboard ship. Refusal to do so is mutiny; go forward and attend to the wheel." Our son, somewhat crestfallen, replied:

"Let mother do the steering for awhile, I'm tired and worried;" then, timidly: "do you really think it is safe to be aboard here?"

I saw it was best to give him a chance to quiet his fears, and as I had already taken the wheel I continued there for awhile, but listening closely could catch now and then a word which convinced me that a mutiny was in active progress aft. My son was nervous, and his tongue was active in argument. My husband was trying to inculcate good precepts in his instructions regarding good behavior and good manners. My son was questioning his father's ability in his new profession, until finally I heard him say:

"Mind me now, go forward! you know too much; your head is getting too large; you are too erudite altogether. Go forward and attend to your duties." As the young knight with the sorrowful countenance came forward, I could not but say.

"Well, *Eruditus*, what's the matter?"

"*Eruditus*," they all cried, "*Eruditus*, ha! ha! ha! that's a good name; very appropriate, too." The name has always stood by my promising son; he is erudite enough at this writing to enter the Massachusetts Institute of Technology, but not old enough by two years to do so. I don't know that anyone can teach him much; he has lived sixteen years and "knows it all."

Now such an experience as the above is startling to a novice, and I don't know any experienced engineer who likes to see his water-glass empty and water going out of the safety valve at the rate of a mile a minute. Our boiler never got foul again. We were three hours and ten minutes going to Augusta—a good tide with us two-thirds of the way. We had had two adventures and were somewhat weary and very, very hungry; even *Eruditus*, who had been eating sandwiches, cookies, cakes, boiled eggs, devilled ham, bananas, pears, etc., all the way. You can imagine what our dinner consisted of, so I'll say nothing about that. We went the rounds of the State's Capitol and paid our respects to the great publisher who lives there; made a few purchases and started for home at three o'clock with a good tide all the way. It was my watch as engineer and I opened her out. No mishaps disturbed us; we sped along at a rapid gait. O what a delightful sensation! how inspiring to glide over the beautiful tide at full speed! a thing of life under your control, watching the lengthening shadows cast by the declining sun, its rays painting the landscape with beautiful tints! True it is that this locality is

A veritable port of rest from troublous toil;
The world's sweet inn from pain and wearisome turmoil.

We arrived home safely in due season. As the boat's head was brought up to the wharf, our Miss S. seized the "painter," in readiness to make fast. She even went so far as to fend off, thus being obliged to stand well forward. As the tide was running strong, the boat began to take a slight sheer, which Miss S. noticed, and endeavored to check by clinging, as well as she could, to the wharf. Of course, it was useless. With her hands on the wharf and her feet on the receding boat, she was not in an enviable position. Mr. M. rushed to her assistance, but it was too late; down, down she went into the water, but not, however, in her "best suit of clothes." Down, down, until the rope still wound around her hand checked her descent. By this time excitement reigned supreme for the third time that day. I did not notice that she had clung to the rope, so I shouted. "She's gone under the boat; she'll surely drown!"

My noble son, *Eruditus*, jumped to the rescue, and overboard he went. I was then doubly alarmed, but he might have spared himself, for Mr. M. was the fortunate one to rescue her. He seized the rope and soon pulled her to the surface. She was a spunky girl and came up smiling, exclaiming: "O, my embroidery-work is all wet!" We soon had her on the wharf, a sorrowful but beautiful object.

Thus ended our eventful trip.

Boston, Mass. MRS. "BUTTERCUP."

[We are sorry that it ended, and hope that the log of the '*Buttercup*' will be continued indefinitely. It far surpasses Lady Brassey's *Voyage of the 'Sunbeam'* in thrilling occurrences and live incidents. We hope Eruditus will continue to be of the ship's company. He is a central and imposing figure.—EDS.]

THE WORK OF AN INJECTOR.

Editors ENGINEER:

At the risk of being called an injector crank, I give my views on the subject.

We can easily calculate how many pounds of water each pound of steam takes into a boiler with an injector by finding how many degrees the steam heats the water in passing through the injector.

An injector is feeding a boiler at 70 lbs. pressure, and the steam raises the temperature of the water from 50° to 110°. How many pounds of water does each pound of steam take into the boiler? In raising the temperature of the feed water from 50° to 110° each pound of water takes 60 units of heat. Total heat above 0 in a pound of steam at 70 lbs. pressure is 1210 units, $1210-110=1100$. $1100\div60=18\frac{1}{3}$. Hence each pound of steam takes $18\frac{1}{3}$ lbs. of water into the boiler.

A pound of saturated steam will heat $5\frac{1}{2}$ lbs. of water 32° to 212°. Some injectors will take water at 32°, and deliver it to boiler at 212°. In this case each pound of steam takes only $5\frac{1}{2}$ lbs. of water into the boiler.

Steam will escape from a boiler under 15 lbs. pressure with 30 times the velocity of the water, and pound for pound will have $30\times30=900$ times the power of the water. If the steam can be condensed instantly after leaving the steam tube of an injector. it has velocity enough to carry itself into a boiler under $15\times900=13{,}500$ lbs. to the square inch.

If all the velocity of a pound of steam was imparted to the feed water, it would take into the boiler 900 lbs. of water. In this case the temperature of the feed water would be raised a little more than 1°. Such a result is never approached in practice. Everyone has noticed dry steam escaping from a gauge cock or pipe from a boiler; the steam jet retains the form of hole from which it escapes for some distance after it leaves the pipe, which shows that the velocity at which it is moving is greater than the velocity of expansion.

Notice the difference between a jet of steam and a jet of water of the same temperature; the water expands or explodes immediately after leaving the pipe. which shows that the velocity of expansion is greater than the velocity of discharge.

Imagine a jet of superheated water coming out of the steam tube of an injector, and we will easily see why a little water will stop an injector working.

If the steam escapes into the combining tube of an injector, where it is surrounded by water, some of the steam is condensed without expansion; it is to the quick condensation of the steam that the injector owes its action, and the quicker it is condensed the more velocity it retains, and the more water it will take into the boiler. Some of the steam retains its velocity after it is condensed, and gives the feed water used to condense it velocity enough to enter the boiler, when guided by properly-shaped tubes. In a reliable injector that velocity must be considerably more than the velocity at which water will escape from the boiler.

If we consider the steam that drives an injector as water moving at a velocity great enough to overcome many times the pressure in the boiler, the principle ought to appear clear to anyone,

Everyone knows who uses an injector that it will work best with cold feed water. Why? Because cold feed water will condense the steam quicker. If we consider the injector as an ejector or pump, the circular jet is the worst form in which it can be made, if we wish to get the most work out of it for the least steam, because the circular jet presents the least area for the condensation of the steam. In a large jet the outside does most of the work, and the steam in the center does little but heat the water.

ALBERT H. HALLADAY.

ALIEN ENGINEERS CAUGHT.

Editors ENGINEER:

There have been several foreign steamers running to this port in the fruit trade for four or five years. Several months ago three of them were Americanized. We thought it strange that there was no vacancies for American engineers and captains, and upon investigating the matter found that the engineers and captains had been Americanized also. The M. E. B. A. No. 13 took the matter in hand, and appointed a committee to investigate the matter thoroughly. Robert B. Dick was made chairman. After considerable hard work the committee found that there had been a wholesale business carried on in procuring fraudulent naturalization papers, and some prominent Americans had been connected with it. These people appeared before the U. S. Local Inspector with their citizenship papers, and after going through the proper examination, were granted licenses. The committee thought, when they had procured sufficient evidence against James Howden, Capt. William Scott, and John Martin, they would have them arrested for perjury. Bro. Dick had warrants issued for their arrest; they were given a hearing, and held in $1,000 bail to appear at court. Bro. Dick also took a rule of court on them, to show cause why their naturalization papers should not be revoked and canceled. This rule was made returnable on the 10th ult. The defendants appeared to answer, and the court decided that Jas. Howden, William Scott, and John Martin obtained their citizenship papers by fraud, and the court ordered that their papers should be canceled and destroyed. Bro. Dick also communicated with one John C. Cuthbertson, who also obtained his papers by perjury, to surrender his license to the U. S. Inspector pending an investigation in his case; he readily complied with the request. Bro. Dick has also taken a rule of court on one James McInnes, Chief Engineer of the Ss. '*Brixham*,' to show cause why his naturalization papers should not be revoked; he has a warrant for his arrest on his return from the West Indies, and there is but little doubt that his license will be revoked. All this has been done with very little expense to No. 13, the defendants being glad to settle the bill. If this business of making foreign engineers could have been carried on for about two years more there would have been enough engineers and captains made to supply the coast. There is plenty of work yet to be done, and a good share of it for the Pilots' Association. If they will take the matter in hand *now*, they would benefit by our experience, and we would be willing to help them. We don't suppose there will be any new candidates of this class for quite a while, as we propose to have a closer watch on this business than heretofore. We could have sent all these people to jail, but that is not the root of the evil; we have got to the root of it, but we have not decided what action we will take in the matter.

Mr. Editor, by publishing this we know it will be well scattered, as your valuable paper is circulated far and near, and it may prove a terror to others who are inclined to go in for that kind of business.

Philadelphia. COMMITTEE.

TRACTION INCREASERS.

Editors ENGINEER:

You had a cut in the last issue which shows a man standing on a scale with a lot of levers rigged to him, endeavoring to increase his weight on the scale by hauling on them. Of course he could not do that, but you say the cut represents the model of a traction increaser on a new locomotive which does not increase anything. Allow me to disagree with you. It is well known that the load can be thrown on or off locomotive drivers, else why do we see statements of such and such loads on drivers and so much on trucks? Particularly are you in the wrong where you say or speak of trailing wheels in connection with the engine you name, for that engine has only one pair of drivers. Now if you will kindly oblige by telling me (and others) where we are wrong in supposing the arrangement you criticise is defective, I shall be glad. A FIREMAN.

New Haven, Conn.

[Suppose we were able to put a bar under a locomotive, and lift it bodily up in the air so that it was balanced truly on the bar. Then its center of gravity would be through the center of the bar. Now suppose we shift the bar toward the back end of the engine; then the bar is out of the center of gravity, and the front end falls, resting on a truck, let us say, which bears a portion of the load; the remainder of the load is resting on the bar. Does our correspondent mean to say that this load can be increased by any mechanical device? We say it cannot, and it makes no difference whether there are one set or two sets of drivers, as regards the principle.—EDS.]

VACUUM.

Editors ENGINEER:

Will you give a student a few points in regards to vacuum. Books that I have read say it is nothing, but that a perfect vacuum pressure is 15 lbs. to the square inch; also, that the atmosphere alone is 15 lbs. to the square inch, or thereabouts. Then I am told, again that for every 2 inches of vacuum shown on the gauge, it is equal to 1 lb. of live steam. How is this?

New York. G. T.

[There are many contradictions in works which are puzzling to beginners. A vacuum is simply a space from which the air has been exhausted. It has no pressure necessarily, for there is nothing to exert pressure. A perfect vacuum then, is absence of everything. Now look at another subject—the pressure of the atmosphere: This is 14.7 lbs. at the level of the sea.. Of course, if a piston has a perfect vacuum on one side and atmospheric pressure on the other, the air will exert a force equal to 14.7 lbs., the vacuum has no pressure whatever; it simply offers no resistance. Suppose a little air leaks into a perfect vacuum, and reduces it by 2 lbs., let us say, then there is said to be pressure above a perfect vacuum to that extent. Steam of 1 lb. gauge pressure is equal to 15 lbs. absolute, as it is called. That is, the reckoning is from perfect vacuum. Since it has been raised against the pressure of the atmosphere, if that pressure is taken away, it is equal to 15 lbs.—EDS.]

◆

IT is significant that the class in wood engraving at the Cooper Institute in this city has been permanently discontinued, owing, it is stated, to the fact that wood engraving is no longer a profitable trade to follow. Process blocks have so cut into it that an ordinary engraver cannot live.

WE KNOW THEM.

THE *Marine Record*, of Cleveland, has this to say in a recent issue concerning marine engineers on the Great Lakes:

> The *Marine Record* has repeatedly urged the growing necessity of more assistance in the engine room, at a time, too, when a discussion of the subject would do the most good, viz.: during the close of navigation, and we are pleased to inform our esteemed contemporary that engineers' assistants are now being shipped, as oilers or greasers, and it is within our province to say that the help is fully appreciated by the owners as well as by the senior engineers. In this connection we take exception to the following paragraph, quoted from the article published in the columns of our contemporary:
>
> "Good men are always scarce, and it is unjust to them to rate them on a par with the idle and dissipated, who are willing to work for anything."
>
> The idle and dissipated find no hold on fresh water. As a class, or as an organization of mechanics, the lake marine engineers are the peers of any skilled workmen on the face of the earth, they reside, work, and maintain good homes year in and year out in close proximity to the men for whom they sail, and conduct themselves at all times in such a manner as to command the respect of the owners who entrust their valuable property into their hands for safe keeping. Such is our candid and undivided opinion. We further admit that we see no reason for continuing a discussion of this subject, when the season of work for all hands has commenced, while it is beyond our province to voice the sentiment of a large class by quoting from personal or individual interviews as opportunity offers.

To this last paragraph, yes. It is not beyond our province, for we represent the other side of the argument, but the question will keep. We happen to know better than our contemporary the effect of the discussion of marine engineers' interests in these columns, for we belong to the M. E. B. A. ourselves, and no one but a licensed marine engineer can become a member. Over our desk hangs a certificate, issued from the port of Detroit in 1858, and in that port THE ENGINEER has over one hundred *subscribers*, to say nothing of readers. It is the same in all the Lake ports as regards our connection, and more marine engineers read THE ENGINEER than any other one or two papers, as it is quite natural that they should. We argue for our own side and its interests, and as yet we have not had any protests. We freely admit that it is too late in the season to effect anything, but there are other seasons coming when we shall have more to say. Till then let us all work as hard as we can and keep our powder dry.

◆

ABOUT six months ago one of the stacks at the Barbour Thread Works, Paterson, N. J., was struck by lightning. The chimney is a square brick structure about 100 feet high. The electric bolt struck it about 30 feet from its summit, cut it in two horizontally, so that the upper section was lifted clear of the remainder and dropped back into place so squarely that it remained balanced and standing, though swaying a little in a strong wind. Not wishing to rebuild the chimney during the winter, the company caused a broad iron band to be rigged around the fracture a little distance outward from the chimney, forming a trough into which cement was packed, thereby rendering the chimney temporarily safe. During the summer the stack will be taken down to the point of fracture and rebuilt.

◆

AT a recent meeting of the American Society Mechanical Engineers, Prof. Denton read a paper on testing lubricants, in which this passage occurs:

> "It seems hardly possible, therefore, that the quality of durability in lubricants can be measured, except by copying in a very perfect manner the exact conditions of arrangement, proportion and method of feeding which are to be used where the lubricant is to be applied; and even when this precaution is taken, the fact that in some kinds of service the limit to the consumption of oil depends upon the extent to which dust or other refuse becomes mixed with it, as in railroad car lubrication, and in the case of agricultural machinery makes it almost hopeless to expect that laboratory tests can contribute very much of practical value in the determination of relative durability of lubricants."

This is the same position we took in No. 10, current volume, on "Bearings," and it is satisfactory to have our views confirmed by so close an observer as Prof. Denton.

THE ENGINEER.

FORTNIGHTLY. - - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, MAY 24, 1890. NO. 11.

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SPECIAL NOTICE.

WE again call the attention of all dealing with us to our business address, which is Egbert P. Watson & Son, 150 Nassau Street, New York, not THE ENGINEER, 150 Nassau Street, New York. There are so many papers in this city which have "*Engineer*" in some part of their title that it is no longer distinctive, and with the immense amount of mail matter passing through the New York Post-Office it is not at all strange that some matter should be misdelivered. Where a postman has hundreds of letters to deliver several times a day it is easy for him to get confused on "Engineer."

We have frequently received money letters endorsed, "Opened by the ——— Engineer," and our exchanges go astray so often that we will thank all publishers to re-direct their labels as above to the firm name only. We never receive any exchanges returned endorsed "opened by," etc., etc.

◆

THE BELLAMY IDEA—LIMITED.

IN various ages of the world men have propounded schemes to benefit their fellows. The wish to escape the hereditary curse of earning one's bread by the sweat of the brow is universal, and there are some who cherish the idea that they can invent plans by which the weak in worldly affairs shall be made strong, the foolish wise, the careless careful, and the indifferent man an ambitious and earnest one. These are all laudable intentions, and when they are universally adopted the millenium will be imminent. The objects above set forth are embraced in a new social scheme for the advancement of mankind, and the chief of it is a man called Bellamy, who has written a book which we have not read, called "*Looking Backward.*" Queerly enough, this book fell flat on the market, as a commercial venture; it did not sell, until by the merest chance a coterie of influential Boston persons took it up, and began to disseminate its views as a basis of a new social gospel, which if lived up to will forever relieve mankind of the ancient curse. They need take no thought for the morrow, or not much thought—and they can pursue the even tenor of their way unharassed by business cares or anxieties. People who depend upon funds in trust for dividends can go about their lawful occasions with the certainty that the dividends will be forthcoming, undiminished in amount. Men who hold other men's notes can sleep soundly, the notes will not be protested; in short, save for battle, murder, sudden death, the freaks of the elements, acts of God, or the common enemy, all sources of care and worriment to mankind are eliminated at once from the general order of life.

The mind which conceived so broad a scheme as that cited above will no doubt yet find some way by which the elements can be controlled, and men insured against all the accidents which now environ them from such sources; and if they are, what then? Before we answer this inquiry let us quote a passage or so from the words of the chief prophet and sage, Edward Bellamy, for this new doctrine which we have mentioned above is a sober fact, and numbers among its followers some of the most learned and able men of the country:

"The Nationalistic movement," said Mr. Bellamy, "is a perfectly natural outgrowth of the times. It would be absurd for me to pretend to leadership in it. There are no leaders. It is in the air everywhere. We certainly seek to change the present social system, but we shall do it through the channels afforded by the system itself, that is, legislation when the proper time comes. Our programme or declaration of principles has not been changed since the first Nationalist club began its work. The principles may be briefly summed up thus: That industrial competition should be displaced by industrial association. This involves the absorption by the Government of all the enterprises or agencies by which men produce food, clothing, fuel, shelter and luxuries, and the means by which they are distributed and exchanged. The phenomena of trusts, by which great economy of labor and superintendence is secured, show that the principle is not only practicable, but in accord with the tendency of the times. We would abolish competition and substitute for it such an association of industries that everything made or done should be reduced to a cost price, for the benefit both of producers and consumers. Government then would be the management of a vast industrial system, in which every man should be a partner. No; this is not State Socialism as I understand it, for we go beyond the programme of the State Socialists in several essential details. In our ultimate society all the workers would be organized after tbe plan of a great army. Every man would have his place and his especial duties under acknowledged commanders or superintendents; promotion would be by merit; retirement from active labor would come after such a number of years as would equitably measure the value of a man's work in terms of production; men or women disabled in the course of their labor would be pensioned, and the pension system would extend to all the retired corps. Under judicious superintendance there would be no more shoes made, for instance, than would be required by the population; no more wheat grown than would be sufficient to supply bread, and so on through every form of productive industry, the absence of competition securing the community against the evils of overproduction. No; this is not paternalism. Many of our critics accuse us of carrying paternal government to an extreme, but we regard this great industrial organization as the acme of truest democracy. The people would rule absolutely through their own organization, and because men would not have to struggle for a lifetime for simple maintenance, they would be the freer to develop individuality. Through the economies of association men would be enabled to cultivate the nobler qualities of their nature. Our principles are really conservative, preservative of the republic even, for at the present rate of the development of association on a gigantic scale, the people will have to decide, at a time not far distant, between submitting as the hired laborers of trust or acquiring the title and control of industries for themselves. Industrial association is the most patent fact of today, and the question comes simply on the adoption of that principle by the whole people and the application of it to their own interests."

This is the scheme as set forth by the schemer of it, and it would be hard to find anything shallower or sillier in conception. All industries are to be in the hands of one central government or head, and all are to be parties in a grand co operative world! No provision is made for Darwinians, who, it seems, are not recognized by Mr. Bellamy; what is to become of them? There are some earnest, virile, and robust men in this world yet, and these do not want to be made partners in anything against their will. They do not want to be run in, so to speak, with the Government, but they do want to manage their affairs in their own way, and sink or swim according to their abilities. In the grand social cataclysm which will occur when the Bellamistic millenium dawns, a few of these virile men will inevitably survive; they will crawl out somewhere on the globe and organize by themselves, and they may make trouble for the Bedlamites. A clause should be inserted in the prospectus of the Nationalist which will effectually dispose of them.

It must be observed that Mr. Bellamy's beautiful faith in the purity of men's motives when they are organized in the form of a "Government," is not shared by the majority of mankind. Their natures are not at all changed by civic honors, and there are quite as many untrustworthy, vain, weak, silly, dishonest men in high places as there are in low. Why success is assumed because labor and industries are centralized is more than we can understand, and as for the trust idea which Mr. Bellamy touches upon, as an illustration of the possibilities of his scheme, we think it an unfortunate allusion. So far as our observation goes, trusts have been, and still are, quite unpopular, and quite unfortunate for many who trusted in them.

But suppose the Bellamy idea is adopted, and these United States became a vast social and business organization, what then? Let us leave out the business aspect of the subject, and dwell only upon the social side of it; what will become of mankind? Without the healthy friction of business cares and anxieties men will become mentally and physically attenuated, atrophied; the lean and slippered pantaloon will infest the landscape; the querulous voice of the satisfied man will be heard on every side; his listless, vacuous face will haunt one; his pale disordered visage will be present everywhere. When there is nothing to plan, nothing to contrive, nothing to guard against, when there are no precautions to be taken against the evil day, when all things are reduced to the dull dead level of certainty, then men will waste in their noblest parts, for they will have no use for a portion of their brains,and some of them would have no exercise for any portion. Only the Government will require to think at all, while the mass can go on marrying and giving in marriage with the certainty that the Government is doing all things well.

Away with such a scheme and such an existence! It is better for a man, a thousand times, that he should die of starvation in a ditch through misapplied energies or wasted ability, than that he should grow sleek and fat in Bellamy & Co.'s social preserve. The man who dies has at least the satisfaction of knowing that he put forth all he could, and that he died fighting, but the man who dies in Bellamy & Co.'s pound—we presume he dies ultimately—dies of inanition, succumbing to too much folding of the hands to sleep. When mankind hire others to think for them, and farm out all their anxieties, cares and ambitions to a central organization they degenerate distinctly and speedily, and, instead of cultivating their nobler faculties in the leisure gained, they foster the grosser ones and become querulous and unbearable. It is our belief that the world will grow wiser and better by individual effort, personal example, and bitter experiences; not through any trust, corporation or Bellamistic Co-operative Society—limited or unlimited.

◆

NOTE ON NEW INVENTIONS.

INVENTORS of this or that device which is intended to overthrow all existing plans and systems often feel that the public do not appreciate their efforts, and leave their invention untried out of sheer pique, indifference to new things, or conservative ideas, which can see no good in anything new. So far as this relates to public travel or to large interests it is a mistaken one on the part of inventors. Capital is always anxious to save even a small percentage of loss, and if a new machine or process actually accomplishes what it claims to it is quickly adopted, but too often the claims made do not exist in fact, but only in the imagination of the inventor, and where this is the case the public find it out quickly. Not many years ago it was discovered that the system for using steam in marine engines was radically wrong, and that greater economy could be had by certain other systems. When the fact was established no other kind of engines than the new were built, and ships which were worth it had their old engines torn out and thrown away, to be replaced by the new system. There was no hesitation, whatever; it was simply the logic of facts. Sometimes the inventor is a pioneer, and makes discoveries which the world is not ready for, but if he is right in his principles and has not discovered a new philosophy of mechanics to fit his machine, he will certainly attain the ends he seeks.

◆

WHY will people strain themselves to invent things for which there is no demand? Here is a Western person who has been to the trouble of rigging up an alarm clock so that it will light a fire. You set the clock at a certain hour, then when it gets there the fire is lighted. All very simple, and all very useless. The pretext for this thing is that one can take "a last nap," while the fire is getting under way! As the clock is about six inches from the fire in the illustration of it, we don't see how the sleeper is going to awake from his last nap in time to save the clock from being melted.

◆

AMERICAN matting, similar to Chinese, is made at Milford, Conn.

EARLY AMERICAN COMPOUND ENGINES.

By CHAS. H. HASWELL, M. AM. SOC. C. E. AND INST. C. E. OF ENGLAND.

[MUCH interest attaches to the history of the compound engine and the origin of it. So far as known the first commercially used engines of this class were built in this country. The London *Engineer* recently published drawings of the compound engines of a Dutch vessel which were built in 1829, but those referred to herewith antedate them by four years. Mr. Haswell says:]

1824–'5.—James P. Allaire, proprietor of the then leading steam engine establishment of the country, constructed a compound steam engine for the steamboat '*Henry Eckford*,' Capt C. Davison, for service in Long Island Sound, New York to Norwich, Conn.

Soon after that in 1825–'6 he constructed the engine for the Steamboat '*Sun*,' Capt. T. Sherman, New York to Albany; the first boat to make the passage from Albany to New York in twelve hours. This was held to be so signal a victory that it produced the following:

> " Then hurrah for the Steamboat '*Sun*;'
> From Albany to New York she come
> In hours twelve and minutes few;
> The time is short, the story's true."

1826–'7.—He also constructed the engines for the Steamboats '*Commerce*,' Capt. Seymour, and '*Swifsure*,' Capt Peck. In consequence of the general distrust of the safety of steamboats at this period, the association owning these boats fitted up two double-decked barges, the '*Lady Clinton*' and '*Lady Van Rensselaer*,' which were towed astern of the boats. This method of travel was very popular for a season, but the reduction in speed, in consequence of the additional labor of the boat, was fatal to the enterprise.

In 1825 and 1826 he built the '*Pilot Boy*,' Capt. Stark, and '*Post Boy*,' designed for towing from the Balize to New Orleans, La.

In 1825.—The '*Henry Eckford*' departed from the foot of Rector Street, N. Y., with two barges in tow, bound for Albany. The street and bulkhead were lined and filled with people assembled to witness the hazardous enterprise of essaying to tow two boats with one. The prevailing opinion was that, inasmuch as it required one engine to propel the boat in which it was set, how could one boat tow two others? I was present and saw her move out triumphantly and proceed on her course.

The engine of the '*Pilot Boy*' was a vertical beam, the high-pressure cylinder having less stroke than the low, it being set on the connecting rod end of the beam. All of the others were vertical cross-head engines, connected by gearing, but inasmuch as the exhaust connection was not in the better manner of late years, and as the steam generated did not exceed 30 lbs., the value of this method was not so manifest as to induce other parties to adopt it; hence compound steam engines were abandoned from this period until some fifteen years past, when the English improved it with a receiver, and operating at a high pressure.

In illustration of the knowledge of the construction and operation of condensing steam engines, entertained by one Western engineer of this period: the '*Pilot Boy*' in 1827 was steamed up to Pittsburg, Penn., for some repairs. Upon being examined by the proprietor of the steam engine establishment to which she was consigned, he declared her poppet steam and exhaust valves to be very objectionable, and the scatterer in her condenser useless, whereupon the first was replaced with slide-valves and the latter removed.

So signal was the failure of these improvements, that her captain came to this city and obtained from Mr. Allaire a set of new steam valves and side pipes, to all of this renewal the writer, I, was a party.

Of all once connected with these vessels, but two persons are now living; Theodosius Secor and myself.

PISTONS AND PISTON RINGS.

A railway master mechanic writes to a contemporary upon the subject of narrow piston rings, and he disapproves of them, saying among other things that they are scrapers, and a contemporary (*Industry*, San Francisco) adds: "A width equal to one-fourth a cylinder's diameter is no more bearing area than a set of rings should have for good service." Try it on a 60' cylinder!

Without desiring to traverse either party, we respectfully present these views for consideration upon the subject of pistons and their rings.

When our grandfathers bored out cylinders they did so under great disadvantages, having poor tools to bore them and poor lathes to make the rings with. They did the best they could, but their best was not good enough, and as the cylinders were rough and untrue they had to have some means of making their pistons steam tight. They therefore slugged gaskets into them with a sledge, and these gaskets had so many interstices, being not round themselves, that they had to be hammered in hard to fill the space. Later, when machine tools were improved, better work was done, and metallic packing was used. Curiously enough, the same practice prevailed in regard to the rings and it is in vogue to this day in most places; that is, in slugging them out as tightly as possible in the cylinder. We assert that this is wholly needless and a great waste of power.

There is nothing in the functions of a piston that require it to be forcibly jammed into the cylinder. It is a sliding partition between the steam and the details of transmission, and it ought to slide as freely as possible. With the machine tools of the present it is easy to make cylinders so round and true that they are practically uniform in bore from end to end. This end attained, the rest is simple. It is only needful to make the piston of such a shape that it shall be light and strong and wholly devoid of followers, bolts, or any external loose pieces of any kind. Above all other points it should actually fill the cylinder with the scantest possible margin for clearance, then the rings may be as narrow as possible; mere steel wires in fact, as they are in Ramsbottoms piston, and they will be tight break joints and not scrape anything. If piston rings scrape it is the fault of the maker of them and in their being too rigid.

From our point of view piston rings are not intended to carry any weight and should be wholly relieved from any portion of the load of the piston. If the latter fills the cylinder, its surfaces are in contact for a much larger arc, then when the piston is made a quarter of an inch smaller than the cylinder, and the rings made to do double duty in holding up the piston and making a steam-tight joint between them and the cylinder.

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SALARIES OF ENGLISH ENGINEERS.

THE salaries paid to English superintending engineers of large works excite our special wonder, when compared with American salaries for similiar duties. The responsibilities are no greater in one case than in another, but the salaries paid in England far exceed those paid here. For example W. Bryce Douglas received, when in the employ of the Fairfield Ship Building Company, $35,000 per annum, and now receives with the Barrow people $50,000, or a salary equal to that of the President of the United States. All do not get so much even in England, but the average is higher than with us. Mr. Sennett receives $15,000 per annum, and Mr. Soper with Humphrey and Tennant $12,750, which is more than twice as much as the best paid American superintending engineer receives. It must be acknowledged, however, that English shipbuilding concerns have very much more business than American, and are better able to pay good salaries.

Foreign and Domestic Trade Literature.

NORMAL INDICATED HORSE-POWER OF MARINE ENGINES AND BOILERS.*

Marine machinery may be said to have two kinds of value—(1) value to the owner, and (2) cost to the builder. These two values are not synonymous, and do not necessarily run parallel with each other for all sizes of even one type of machinery. It is the first kind of value with which we are chiefly concerned, but the relation of the second to the first will also be touched upon briefly.

I.—Value to the ship owner or user.

It is obvious that the ultimate and only real value or worth of any machine is its value or worth to its owner or user. In proportion as it fulfills the purpose for which its owner intends it, will its value be measured. This kind of value, like other commercial values, fluctuates much owing to varying circumstances, and it may be impossible to express it with any accuracy or uniformity in £ s. d.; but it is, nevertheless, a real value. Some cases there are, even in commercial practice, in which wear and tear, consumption, and other adjuncts, are of less importance than in others, but in no case are they of no importance at all. We, therefore, assume that the rule required is one which expresses in convenient mechanical units or terms the value to the shipowner of his propelling machinery.

The horse-power shown by the indicator is no criterion of the value of his machinery to the shipowner, unless he were possessed of some magic formula by means of which he could reduce this horse-power to the common denominator of a uniformity of all possible conditions under which engines and boilers are worked. Of such a formula he is not possessed, nor is he ever likely to be possessed of it. To compare the values of two engines by comparing their actual i h.p. is—in the absence of identical working conditions—like comparing the values of the numerators of two fractions, without first reducing them to a common denominator.

Any given size of engines can be made to indicate vastly increased power by simply running them at a greater number of revolutions, or by increasing the period of admission of steam in the high-pressure cylinder, or by both of these means combined; any given size of boiler may be worked very much beyond its normal power by forcing the fires. But this increase of power is obtained at the cost of increased wear and tear and increased fuel consumption, unless, indeed, it be possible to introduce some compensatory arrangements or devices in the case of the higher power engines and boilers. Apart, however, from the question of the possibility of introducing such arrangements, it is distinctly borne in mind that no elements beyond size of engines and boilers and working pressures, can possibly be included as factors in any general rule. In the meantime, in order to show distinctly what is meant when it is said that the actually developed horse power is no criterion of value, take an example of two different engines indicating the same power.

As it is in the engines where the greatest variation of power is possible, the boilers are, for the sake of simplicity, omitted. The working pressure of both is also assumed equal—viz., 150 lbs.

$$\text{Say engine No. 1, } \frac{24-38-62}{36}.$$

$$\text{Engines No. 2, } \frac{21-33-54}{42}.$$

These two engines may be made without difficulty to indicate the same horse-power, and on this basis of value they would, therefore, be ranked as equal. Their proportions are in nowise abnormal, but are such as are to be met with in everyday practice. Assume the i. h. p. to be 1,230 in both cases, and to fix ideas, let the mean pressure, reduced to the low-pressure cylinder of No. 1, be 28 lbs., the revolutions per minute being 80. In ordinary circumstances it is very probable that the mean pressure and revolutions of No. 2, when indicating 1,230 horses, will be about 31.6 lbs. and 80 revolutions. If this is so, then No. 2 must expand the steam less than No. 1, and so far as economy is affected by degree of expansion, the water consumption, and, therefore the coal consumption, of No. 2 will be higher than No. 1 to the extent of about 3½ per cent. It is next to be noted that both engines are running at the same revolutions per minute, and therefore the longer stroke engines must—other things being equal—undergo more wear and tear. In respect, therefore, of both coal economy and wear and tear, No. 2 engines are inferior to No. 1. If No. 2 is made to equal No. 1 in coal economy, then No. 2 must run at the still higher speed of 90 revolutions per minute, thus very greatly increasing the piston speed and whatever evils or disadvantages this brings in its train. If, on the other hand, the revolutions of No. 2 be reduced to 72, which would bring both engines to approximately equal conditions as regards reciprocation and its effects, the coal consumption of No. 2 would rise to about 7 per cent. above No. 1. In this last speed the mean pressure of No. 2 will be about 35.1 lbs.

These figures are given in tabular form below:—

		M.P.	Revs.	i.h.p.
(1.)	$\frac{24-38-62}{36}$	× 28	× 80	× 1230.
(2.)	$\frac{21-33-54}{42}$	× 31.6	× 80	× 1230:
or,	do.	× 28	× 90	× 1230;
or,	do.	× 35.1	× 72	×1230.

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THE LESSON TO BE LEARNED FROM THE 'CITY OF PARIS.'

English marine engineers and naval architects are taking the accident to the '*City of Paris*' very much to heart, and endeavoring to profit by it. Numerous letters have been written to trade papers upon the subject, and among others this one to *Industries*:

"The particulars of the breakdown of the '*City of Paris*' naturally make engineers ask if the modern triumphs of shipyard construction are quite what they are supposed to be. Certain it is that but for the strength and subdivision of the hull, which saved the vessel in the emergency, the ship must certainly have foundered.

There can be no longer any doubt that the breaking of the propeller shaft was what happened first. In the anxiety to have the propeller as far aft as possible, to get solid water in which to turn, and at the same time to present as few obstacles as possible along the ship's run, it seems there was no support given to the shaft from the stern tube down to the boss held up by the usual brackets just forward of the propeller itself. This was for a length of between 50ft. and 60ft. At one end the shaft was 20in. diameter, and at the other 15in.; there would, therefore, probably be about 20 tons weight to carry outside the ship. This would be borne by the boss alluded to. The liners of this boss have worn down about 8in., proving what happened. Either, then, the original design of this detail must have been faulty in some particular, or, what is more probable, the bearing surface was not large enough for such a weight. However this may be, the shaft in dropping this depth broke off next to where it was held up forward, that is, outside the stern tube. Such a result was certain to follow from the first defect, as it is clear there would be a bending moment tending to fracture of over 500 foot-tons. That such an accident is novel may be accounted for in two ways. First, there are very few twin-screw vessels built at all, and fewer still of this size and power. Conditions that apply to small types are of no avail when the dimensions become increased. Is it not just possible, then, that this is where the mistake has crept in? Instead of taking a big problem, like this undoubtedly is, as a new one, deductions were made from previous examples with the subsequent evil consequences. It is safe only to draw conclusions from what has gone before, when there is ample material to hand on which to work. There can be no doubt that a temporary blow has been struck against twin-screws on ships, and the opponents of the system will be professionally jubilant for a time. It may be taken for granted, however, that boats under a certain tonnage are safe when built in this way. It is when the powers and weights are excessive, as in the large liners, that a new set of circumstances come into play altogether, and it is not rash to predict that the design of the after parts in the shafts of these double-screw leviathans will be somewhat modified in future. Detailed suggestions would be out of place without drawings, but they will occur to every engineer.

When attention is paid to the engine-room, where the effects of the racing of the shaft, small though it may have been, were felt immediately, the peculiar feature is that only the low-pressure engine gave way. The high and intermediate engines remain intact. As all three engines drive the one shaft, the racing should affect them alike. The obvious difference is in the diameters of the cylinders, which are 45in., 74in and 113 in.—that is, 9½ft. for the largest. Now any sudden strain on the low-pressure piston requires to be specially provided for. As in the boiler one safety valve is not depended upon, so in a structure of these dimensions, even if a good governor be fitted to the engines, it is unwise to look to a small relief-valve for full security. It is not known what the size of the valve in the present instance may be, but clearly it was inadequate for what was required of it. Probably it will be found that as the engine increased in area, if the valve did likewise, it was an arithmetical rather than a geometrical ratio—in short, allowance was not made for any catastrophe such as the one that has occurred. It is a costly experiment to demonstrate that when we get to these very large engines dangerous ground is being trod upon, and that what are minor matters in a small engine become magnified to considerable importance under other conditions; but if a purpose has been served in this way, perhaps consolation may be derived from the fact that the engineers who were in charge of the machinery have withstood the ordeal and escaped with their lives.

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ALUMINIUM AND ITS USES.

At the present time we are constantly seeing paragraphs in the daily press, and also in so-called technical journals, describing new processes for extracting aluminium from its ores, and also giving absurdly exaggerated accounts of the usefulness of this metal and its alloys in the industrial and artistic world. There are two ways in which damage can be done to a valuable discovery—viz., by abuse and by over-praise. That aluminium may not eventually have to be saved from its friends is by no means uncertain, and this baleful influence can only with certainty be removed by its advocates strictly honoring the limits of truth.

It may be remembered that Mr. J. H. J. Dagger, F. C. S, F. I. C., read a paper on "Aluminium" before the last meeting of the British Association. This paper was so valuable, and so much interest was aroused by it, that the Cowles Syndicate asked Mr. Dagger to prepare a supplementary account of the properties and functions of this metal. We received a copy of this pamphlet a few days ago, and we consider the information contained in it so reliable, and the method of putting the facts together so excellent, that we give it as follows in full :

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* Paper by R. L Weighton, M. A., read before the North-East Coast Institution of Engineers and Shipbuilders.

"It is now 136 years since Margraff proved that alumina is a metallic oxide, sixty-two years since Wohler first obtained metallic aluminium, and thirty-six since Deville's historical experiments produced the metal *en masse* for the first time. Modifications of Wohler's and Deville's methods are still the chief of the processes for producing metallic aluminium, but as these methods involve the use of sodium they can never be the sources of the metal which, according to the enthusiastic journalists and leader-writers, is to be the material of our Atlantic liners, bridges, and locomotives in the coming "Aluminium Age." As far as our knowledge at present will allow us to prophesy, it is certain that the eventual method must be one of direct reduction. The first advance in this direction was the discovery made by Cowles that the use of the intense heat of the electric arc made it possible to reduce aluminium directly from its ores. Unfortunately, up to the present time it has been found that, in the absence of an alloying metal, the liberated aluminium absorbs carbon and is converted into a carbide, and so nothing richer than 80 per cent. aluminium has been obtained. Still there is every hope that, at no very distant date, it will be possible to overcome this difficulty and to obtain aluminium direct from the furnace.

TABLE I.—*Comparison of Iron and Aluminium.*

—	Aluminium		Cast Iron.		Wrought Iron.	Steel.
Color	Bluish-white					
	Cast.	Rolled	White.	Grey.		
Density	2.5—	2.7	7.5	7.1	7.8	7.7—7.2
Tensile strength in tons per square inch	12—	17	7—	9	19—27 Boiler-plate 40—45	30—38 Rolled Bessemer 48—52 Rolled crucible 50—53
Melting point	1300 deg. F.					
Average weight per cubic foot in pounds	162		450		485	490

TABLE II.—*Strengths and Densities of Copper-Aluminium Alloys.*

Grade.	Tensile Strength per Square Inch.	Elongation.	Density.
per cent.	lb.	per cent.	
"A" special (11)	90,000–100,000	0— 8.0	7.23
"A" bronze (10)	75,000— 90,000	4—14	7.69
"B" " (7½)	55,000— 65,000	20—40	8 00
"C" " (5—5½)	35,000— 45,000	30—40	8.37
"D" " (2½)	30,000— 35,000	40—50	8.69
"E" " (1½)	25,000— 30,000	40—55	

TABLE III.—*Compression Tests made at Watertown Arsenal, U. S. A.*

Original Length.	Shortened to Inches.	Original Diameter.	Increased to Inches.	Ultimate Strength.	Ultimate Strength.	Specimens (Casting).
in.		in.			lb. per. sq.in.	
2.00	1.705	.798	.865	80,200	160,400	"A" 1 bronze
2.00	1.525	.798	.914	76,800	153,600	"A" 2 "

TABLE IV.—*Tests of Aluminium Brass.*

Aluminium Brass.	Tensile Strength in Castings per Square Inch.	Elongation.	Density.
No.	tons	per cent.	
2	30—35	2— 7	8.05
3	26—27	14—15	8.15

TABLE V.—*Transverse Test of No.2 Aluminium Brass.*

Cross Section of Bar in Square Inches.	Length between Supports in Inches.	Breaking Load.	Limit of Elasticity.
1	12	8064 lb. 72 cwt.	6496 lb. 58 cwt.

Before proceeding to give some account of the chief value of aluminium in the arts and industries of to-day, a few words may be said about the physical properties and uses of the pure metal. Much misconception exists, as to the purposes and conditions under which it would be possible to use this metal, if produced as cheaply and in similar quantity to iron, and comparisons have been made which are certainly misleading. For the sake of more clearly explaining the matter, we give in Table I. the physical data of the two metals side by side. From these figures it will readily be seen that, although aluminium is only one-third the weight of iron, it has little more than one-half the tensile strength of the best wrought iron, and only one-third that of mild steel, facts which would tell very materially against its replacing these metals in shipbuilding and for structural purposes. There are, of course, many circumstances in which aluminium might replace iron with advantage, but statements like the following are fallacious and misleading: "An Atlantic liner, built of aluminium, would have one-third the draught, and be propelled with the same engine power at double the speed that it is at present when built of iron ; bridges built of this metal would be quite as strong as if built of iron, but would be only one-third the weight."

The chief demand for aluminium is at present—and probably always will be—in connection with its alloys. The use of the metal itself will be chiefly for light machinery, fittings for lighting and water supply, astronomical and scientific instruments, and art metal work generally. With copper, aluminium forms a series of beautiful alloys, varying in color from bluish-white to red-gold and pale yellow, differing very widely in physical and mechanical properties. Those containing 60 to 70 per cent. aluminium are very brittle, glass-hard, and beautifully crystalline; with 50 per cent. the alloy is quite soft, but under 30 per cent. the hardness returns. The 20 per cent. bronze has a whitish yellow tint, somewhat resembling bismuth. It is very brittle, and can be pulverized in a mortar. The brittleness of alloys above 11 per cent. prevents their use, but from 11 per cent. down to 1 per cent. they are most valuable. Their physical and mechanical properties render them useful for every variety of metal work, and the high price of aluminium has been the only restriction to their use hitherto. Table II. gives the range of tensile strengths and density in castings of these alloys. In resistance to compression, A grade (10 per cent.) equals the best cast steel, its transverse strength or rigidity is about forty times greater than of ordinary brass, and its limit of elasticity equals that of steel of the same tensile strength and elongation. The results given in Table III. were obtained at Water town Arsenal, U. S. A. One of the most valuable properties of these alloys is the fact that they are forgeable, and can be worked at a bright red heat as easily as wrought iron, all other bronzes are "hot-short." The rolling of sheets, rods, bars, and wire, is done at a bright heat; only the finishing is done in the cold. A casting of B grade (which had a tensile resistance of 60,000 lbs. to 65,000 lbs. per square inch), with 20 per cent. elongation when rolled, showed 83,000 lbs. tensile resistance, with 30 per cent. elongation. These alloys retain their strength through a high range of temperature, a quality most valuable in a metal. Their resistance to corrosion, which is only a degree short of that possessed by gold and platinum, makes them invaluable to shipbuilders, marine, hydraulic, and sanitary engineers. This quality, combined with their color, renders them far superior to ordinary bronze for art metal work and statuary. The advent of smokeless powder, with its greater corrosive action on ordinary gun-metal and steel, is already causing military engineers to look for a material to replace these metals in the artillery and small arms of the immediate future, and, in the peculiar combination of properties required, aluminium bronze is unapproachable by any other metal or alloy, and the solution of this question will undoubtedly lead to a great demand for these alloys. The aluminium brasses are made by combining the metal with copper and zinc, yielding close-grain homogeneous and remarkably tough alloys. They are made in two grades. (See Tables IV. and V.) These alloys can be forged hot: their special casting properties, high corrosion resistance, and low specific gravity render them most valuable for hydraulic and engineering purposes. A propeller blade can be made of No. 2 brass at least one-third thinner than cast iron. The high elastic limit, surpassing that of alloys used hitherto for this purpose, would greatly lessen the chance of injury to the blades, in the event of contact with wreckage, whales, etc., at present a frequent source of danger and delay. In these days of fast steaming the weakening of blades by pitting and corrosion would be reduced to a minimum if made of aluminium brass.

This is but one of the very many instances which will readily present themselves to the minds of readers who will compare the physical data given above with that obtained from other alloys and metals which it will doubtless supersede as its qualities become more known. Not only is aluminium valuable in its alloys with copper, but it is of service in iron and steel working, giving sound castings, and increasing the tensile strengths. The alloys with zinc, nickel, tin, and manganese are of great interest, but space will not permit of anything beyond a brief note on a few of the properties and applications of a metal which may be truly described as one of the most valuable for the use of the engineer and general craftsman.—*Industries.*

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HOW THEY TAKE THE CENSUS.

ALL the work of the census is provided for by law. The force and their salaries are also provided for by law. Congress has appropriated $6,400,000 to provide for the taking of the census, exclusive of the cost of printing, engraving and binding. One million dollars is appropriated at once. There is little doubt but that if the expense runs over $6,400,000, Congress will provide the sum necessary.

The headquarters of the Superintendent of Census is at Washington. He gets an annual salary of $6,000. The Secretary of the Interior has the power to establish the number of the employees, provided their salaries no not in the aggregate, together with the other expenses, run over the appropriation of $6,400,000.

The great bulk of the force is outside of Washington. The Secretary of the Interior has already designated, on the recommendation of the Superintendent of the Census, 175 supervisors of the census, each one of whom has charge of a different subdivision of the country. These supervisors are practically foremen. Each one of them hires as many enumerators as he and the Superintendent think best. It is his duty to divide his district into subdivisions of the most convenient size, and to assign one enumerator to each subdivision. In the selection of the enumerators, preference is given to veterans. Wherever possible, an enumerator is to be appointed from a subdivision in which he lives, so that a man who is familiar with the people in the neighborhood may be selected. Where no one in the district is appointed enumerator, some resident of the county is appointed.

Each of the 175 supervisors receives $125 pay, with an additional dollar for each thousand people, or major fraction of a thousand, in his district, if the district is thickly settled, and $1.40 where the district is sparely settled. Besides this he gets an allowance for clerk hire, provided the total that he receives does not amount to more than $500. This is to pay the Supervisor for all of his work. There is no salary attached to the position. The payment is made in a lump sum, so that he will be anxious to do his work and get through as speedily as possible.

An enumerator gets two cents for each living inhabitant, two cents for each death reported, fifteen cents for each farm, twenty cents for each factory, or similar establishment, and five cents for each surviving soldier, sailor, or marine, or widow of one. If the Superintendent of the Census does not think this is enough, he can raise the pay to six dollars a day, or to three cents an inhabitant, twenty cents a farm, or thirty cents a factory. In any event, the pay of the enumerators is not to be less than three dollars a day each. This is to avoid the trouble which there may be through the enumerators prolonging their work, as they might be tempted to do if they were working on salary. It is easier for an enumerator to get names in a small town or in the country, so there is a different rate according to the population. No enumerator is to be paid any mileage or traveling expenses, except when authority has been granted in advance by the Superintendent. No enumerator is to have more than four thousand inhabitants assigned to him. The subdivisions are made on estimates based on the tenth census, the boundaries as nearly as possible coincide with the similar divisions of the last census, and are fixed by rivers, roads, and other easily distinguishable lines.

All of these matters are prescribed by law.

These laws provide definitely what questions shall be asked, what results shall be published, how many enumerators and supervisors there shall be, and how much they shall be paid. The Revised Statutes contain a list of the questions to be asked, but both the acts of 1879 and 1889 add to this list. The questions now to be asked are as follows: The names, ages, sexes, relations, place of birth, and civil relations of all inhabitants; their physical and mental health, the length of time they were employed, their trade or occupation, attendance at school, ability to read, write and speak English, and additional questions in case the inhabitant is a head of a family, a farmer, or engaged in business about which statistics are collected.

This makes schedule one, and is prepared in sheets. Each sheet has space for the names of twenty people. It has a printed head with blank spaces to be filled in to show the supervisor's district, the enumerator's district, name of the city, town, township, precinct, district, beat or other minor civil division; the street and number, county, ward and State, or the institution. There is also a space for the name of the enumerator and additional spaces to show: "Number of dwelling house in the order of visitation," "number of families in this dwelling house," "number of persons in this dwelling house," "number of family in the order of visitation," and "number of persons in this family." Under these are printed the various questions to be asked. There are twenty-five of these, as follows: (1) Christian name in full, and initial of middle name. Surname. (2) Whether a soldier, sailor or marine during the civil war (U. S. or Conf) or the widow of such person. (3) Relationship to head of family. (4) Whether white, black, mulatto, quadroon, octoroon, Chinese, Japanese or Indian. (5) Sex. (6) Age at nearest birthday. If under one year give age in months. (7) Whether single, married, widowed or divorced. (8) Whether married during the census year (June 1, 1889, to May 31, 1890). (9) Mother of how many children, and number of these children living. (10) Place of birth. (11) Place of birth of father. (12) Place of birth of mother. (13) Number of years in the United States. (14) Whether naturalized. (15) Whether naturalization papers have been taken out. (16) Profession, trade or occupation. (17) Months unemployed during the census year (June 1, 1889, to May 31, 1890). (18) Attendance at school (in months) during the census year. (19) Able to read. (20) Able to write. (21) Able to speak English. If not, the language or dialect spoken. (22) Whether suffering from acute or chronic disease, with name of disease and length of time afflicted. (23) Whether defective in mind, sight, hearing or speech, or whether crippled, maimed or deformed, with name of defect. (24) Whether a prisoner, convict, homeless child or pauper. (25) Supplemental schedule and page.

These inquiries must be made about each family and at each farm. Each of these sheets is expected to be used for only one family. Single sheet schedules are provided for families containing not more than ten persons. Double-sheet schedules will hold statistics for twenty persons. Additional sheets are provided for families of more than twenty persons, also in the cases of boarding houses, hotels, schools, hospitals and other institutions.

The questions which are to be asked of the head of a family and at farms are five in number. They are: (26) Is the home you live in hired, or is it owned by the head or by a member of the family? (27) If owned by a head or member of a family, is it free of mortgage? (28) If the head of the family is a farmer, is the farm he cultivates hired, or is it owned by him or by a member of the family? (29) If owned by the head or member of the family, is the farm free from mortgage or encumbrance? (30) If the home or farm is owned by the head of or member of the family and mortgaged, give the Post Office address of owner.

The Superintendent, supervisors, and enumerators have to take oaths that they will take the census in conformity with all these legal instructions and that they will make correct returns. Any supervisor or enumerator who shall start out to do the work and who does not do so properly shall be punished He shall also be punished, if he imparts any information to any one not authorized to receive it, if he turns in any false certificates or fictitious returns, or if he takes extra compensation or pays to secure his appointment or divides his fees with any one.

Every person over twenty years of age must tell the Superintendent, supervisors, or enumerators true answers to all these questions to the best of his or her knowledge. If this is not done, a fine not exceeding $100 may be imposed. Every president, treasurer, secretary, director, agent or other officer of every corporation, from whom any of these answers are required, must tell the truth and the whole truth, or he may be fined up to $10,000, and imprisoned up to one year.

This schedule one is the most important. Its results will appear in the first volume of the census. It is doubtful how accurate the results will be, as some persons will hesitate to answer truthfully all the questions therein asked.

There are many special schedules. The insane have a special schedule. The sick of various kinds have a schedule. There are special schedules for statistics about families, the record of their births and deaths during the last five years. There is also a special schedule on mortality and sickness, with statements to be filled by attending physicians. It is intended under these to collect statistics about imbeciles, suicides, and all chronic and contagious diseases.

There is a vast amount of work involved in the taking of the census of the United States. The schedules show only a small part of it. The material must be collected, classified, and counted before its results can be shown. This work for the tenth census took thousands of clerks, computers and copyists. A great part of the work will be saved this time by counting machines, type writing machines, and other similar inventions. The number of inhabitants may be fairly well known before the year is over, but it will be years before all the results of the census will be published.—*New York Sun.*

COMPOUND AND TRIPLE-EXPANSION ENGINES.

Professor Kennedy, as chairman of the Research Committee on Marine Engine Trials, presented to the Institution of Mechanical Engineers lately a valuable report on the performance of the engines of three steamers, the '*Fusi Yama*,' '*Colchester*' and '*Tartar*.' His investigations are of special interest in that they show the performance of both ordinary compound and triple-expansion engines. The more carefully we examine such reports, the more evident does it become that a true theory of the steam engines has yet to be prepared. We meet at every turn anomalies, incongruities, contradictions, puzzles, for which no satisfactory explanation presents itself. It becomes daily more and more evident that there are some subtle influences at work, the nature of which is not fully understood. No man living can form the least idea how it is that the heat of steam is transmitted into mechanical work. When we state that a horse-power represents 42.7 units, and that a pound of steam contains, say, 1100 such units, we have scarcely advanced beyond the confines of our subject, and the hard-and-fast statements which have been laid down by professors, or find their way into text-books, are often flatly contradicted by incontrovertible facts.

Any of our readers who will read Professor Kennedy's report with care will find abundant examples of these truths. Let us take for example the old, well-worn heat-trap theory, which enjoys a most astonishing vitality. According to that theory, the amount of steam condensed in a cylinder is largely, if not wholly, measured by the range of temperature in the cylinder. At first sight this is no doubt a plausible proposition; we feel instinctively that if it is not true it ought to be true. It follows as a corollary, that in an engine in which the range of temperature is kept as small as possible, the condensation will be of minimum amount. In the triple-expansion engine this principle is carried out: the difference between the temperature of the metal and that in the steam is kept as small as possible; each cylinder acts as a trap to catch heat which would otherwise be wasted into the condenser; and the scientific world is told over and over again that the reason why the triple-expansion engine is so economical is to be found in the small cylinder condensation, which follows on the small range of temperature in the cylinders. The hot steam, fresh from the boiler, flows into a hot cylinder, and although the low-pressure cylinder is cool because of the influence of the condenser, still the steam in it is also cool, having fallen in pressure. Nothing can be more elegant than certain enunciations which we have seen of this theory. It is apparently scientifically sound; it exudes physical truths at every pore. It has, indeed, only one defect, and that is, that it is flatly contradicted by the results of experiment. In time cognizance will be taken of this circumstance. At one period a full contradiction of it was ventured upon, but that has been given up and we are left face to face with the remarkable and puzzling fact that the high-pressure cylinder of a triple-expansion engine is always drowned with water, and that no one makes the least attempt to explain why this should be so. Silence on the point proceeds, we believe, from the circumstance that it is seen that any explanation of the phenomena must apparently contradict received thermo-dynamic aphorisms, which have become respectable by a long course of immunity from the consequences of their fallacy. Professor Kennedy's report may be quoted as supplying direct information as to the soundness or otherwise of the heat-trap theory.

Let us take the case of the '*Fusi Yama*.' This is a vessel with compound engines running at a slow speed. They are large engines for their power, and it is commonly believed that nothing tells more against economy than the use of cylinders too big for their work. We need not add that high speed is always looked upon as conducive to economy. Now, these engines, with cylinders 27in. + 50in. × 33in., only ran at 55½ revolutions per minute, and indicated but 371 h.p. The cylinder condensation, one would say, ought to have been heavy. Yet, curiously enough, it was only 11.8 per cent. of the whole steam in the high-pressure cylinder; and it rose to 29.3 per cent. in the low-pressure cylinder; and be it noted that the cylinders were not jacketted. The pressure, absolute, was 70 lbs. on the square inch. Now, if we compare this with the results obtained with the '*Meteor*,' we shall see what the heat-trap theory is worth. The '*Mete-*

or's' engines are jacketted, and run nearly 50 per cent. faster than the '*Fusi Yama's*' engines. Yet we find that there was 22.9 per cent. of the steam condensed in the high-pressure cylinder, or as nearly as possible twice as much as in the case of the '*Fusi Yama';* while in the low-pressure cylinder there was less—24.7 per cent. Is there any explanation of this? It may be said that the steam in the '*Meteor*' was hotter than in the '*Fusi Yama*' by 58 degrees. But according to theory, it is not the temperatures, but the difference in temperatures, with which we have to do; and there is no reason why the difference should be greater in the '*Meteor*' than in the '*Fusi Yama,*' and every reason why it should be less—that is, if there is any virtue in a jacket. Here, then, we have the broad fact that the cylinder condensation in a jacketted engine is just twice as great as in an unjacketted cylinder.

Next let us see what the performance of the '*Colchester's*' engines has to tell us. These engines are 30in.+57in.×36in., not, it will be seen, very much larger than the '*Fusi Yama's*' engines. They are not jacketted. The engines made 87 revolutions per minute, and each pair indicated about two and a half times the power of the '*Fusi Yama's*' machinery. Here we find that the high-pressure cylinder condensation reached 28.3 per cent., and the low-pressure 47 per cent. Thus the high-pressure cylinder is somewhat worse than the high-pressure cylinder of the '*Meteor,*' and the low pressure cylinder very much worse. Why, we must ask here, was the condensation so much greater in the '*Colchester's*' engines than in those of the '*Fusi Yama*'? The absolute pressure in the '*Colchester's*' boiler was 95 lbs. Had the increased pressure anything to do with the matter?

The last engines tested were the triple-expansion engines of the '*Tartar,*' and the results obtained by Professor Kennedy are so curious that he has been at some trouble to supply an explanation, which, if correct, unfortunately deprives this costly and elaborate experiment of all value. The cylinders are 26 in. + 42 in.+ 69 in. × 42 in. The low-pressure and intermediate cylinders had steam in their jackets, but there was no steam admitted to the high-pressure jacket. The absolute pressure was 136 lbs., and the revolutions 72 per minute. This is all favorable enough to economy. Yet Professor Kennedy finds that there was no less than 54.8 per cent. of condensation in the high-pressure cylinder. Continuous re-evaporation appears to have taken place as the pressure fell, and at the end of the stroke in the low-pressure cylinder there was 39.3 per cent. The result is so astounding that Professor Kennedy says that the boilers must have primed continuously during the whole experiment. It does not appear, however, that anything was known of this priming at the time. The boilers are large and were quite clean, but not new; and it is not easy to see why priming to the extent of at least 10 or 12 per cent. of the feed water should have taken place. Assuming that it did, however, it is clear that nothing worth mentioning that is not puzzling is to be deduced from the performance of the '*Tartar.*'

Now let us turn to the behavior of the steam in the low-pressure cylinders of these engines. It is clear that the heat-trap theory does not effect these; the condenser does its worst with them. The back or exhaust pressure represents the measure of frigorific influence at work. There is very little difference in this respect among the engines. In the '*Meteor*' there was a little increase in condensation, the percentage rising from 22.9 in the high to 24.7 in the low-pressure cylinder. In the '*Fusi Yama,*' the percentage rose from 11.8 in the high to 29.3 in the low-pressure cylinder. In the '*Colchester*' it rose from 28.3 in the high to 47 per cent. in the low-pressure cylinder. It is almost invariably the case in the experiments carried out by Professor Kennedy that the water increases in the low-pressure cylinder. How is it that the '*Tartar*' supplies such an astonishing exception to this rule? Not less than 15.5 per cent. of the feed was re-evaporated in the cylinders after the cut-off had closed. From whence was the heat derived that did the work? The fall in pressure was from 130 lbs. absolute to 22 lbs. absolute. Each pound of water that came into the cylinder as priming carried with it 347 units, and in falling to the terminal temperature, 233 deg., it would give up 114 units. A pound of steam at 233 deg. represents 950 deg. latent; so that 8.33 lbs. of water, in cooling from 347 deg. to 233 deg., would supply heat enough to convert 1 lb. of water at 233 deg. into steam of the same temperature. That is to say the water carried into the cylinder as priming could only re-evaporate less than one-eighth of its weight, or under 12 per cent. It may be said that, as this is within 3.5 per cent. of the actual re-evaporation, it is near enough. But that is simply to ignore facts. In all the other cases named there was progressive condensation growing greater and greater. In this case the condensation becomes less and less, and we find by calculation that there was not heat enough supplied to the cylinder to account for this re-evaporation. This is a very curious thing, which no doubt admits of explanation, but that explanation does not appear in the report, and the statement as it stands supplies another example of the anomalies which all records of the performance of steam engines present. For the moment we venture to doubt the soundness of the deductions drawn from the diagrams.—*London Engineer.*

• ◆ •

ENGLISHMEN have been known to pride themselves upon the quality of their workmanship and the thoroughness with which they do their work, but it is evident that there are some English shops where careless work is done. Witness this letter to an English paper from a resident in South Africa.

"Plants" have been sent out here by makers of reputation so carelessly packed and marked, that the cases, on being opened, have been found to contain parts of another plant, requiring extensive "fitting," or else perfectly unsuitable for the plants of which they were supposed to form part. Bolts are sent and marked, which by no possibility could have been intended to hold down the parts correspondingly marked; whilst sometimes important parts are entirely wanting, and have to be supplied here at an enormous extra cost and delay.

Many plants, batteries, head gears, hoisting and pumping engines, etc., are sent out without ever having been fitted together by the maker; one iron head gear had scarcely one hole fair, some were half-holes, and others entirely blind; the teeth of the spur-wheels and pinions have had to be chipped and filed, and in one case new gearing substituted; the cost of this, with cast-iron at 1s. per pound, can be easily imagined. Battery timbers have been sent out with all holes bored (presumably by template), and the parts marked for their places; but on erection it was found that the templates had evidently been turned upside down, and that generally the holes did not come in fair. These timbers are sometimes cross-grained and rotten, and in one case I poked a walking-stick 2 ft. into a battery upright, before erection. All this could have been easily avoided had the machinery been erected and inspected before leaving the shop.

• ◆ •

Young man: "I understand you want a young man to help edit your paper."

Editor: "Yes, sir; have you had any experience?"

Young man: "I have taken one term in journalism at Cornell University and——"

Editor: "That will do. You may take my desk and go to work, and I'll go and run the elevator. Please be as kind to the rest of the staff as you can."—*Judge.*

WHEN the American publisher hears of the great number of book-buyers here, he asks, Where are they? He knows that school-books, text-books, and books of reference sell largely, and that occasionally there is a great rush for a novel of some kind. But if there are twenty readers in this country to one in England, or ten to one, or one to one, where are they? He finds English literary journals teeming with announcements, and many houses ceaselessly producing volumes which would soon ruin any publisher that should put his capital in them here, and wonders again where the great body of American readers is to be found. For books of science, for standard histories, for books of information, there is considerable demand; but for books of imagination outside of fiction, books strictly intellectual in character, that come distinctly under the name of literature, there are very few buyers indeed. One of our great publishing houses fortifies itself with its periodicals, another with its school-books and cyclopædias, another with a great printing establishment; but no house can stand alone in the field of bellettres and survive. The houses that have attempted it have gone by. There is a public that devours the newspapers; a public that buys the magazines, sometimes mainly for the pictures; a public that idles over the last sensational novel; but the public that exhibits a genuine taste for higher reading is very limited indeed.—*The Newsdealer.*

• ◆ •

"BAIL is an agreement by a person possessing property to pay the State a certain sum of money, in case an accused person does not behave himself or herself for a certain time." In the case of a charge of disorderly conduct it is called a recognizance for good behavior. It is an agreement that if the offense is repeated the amount of bail will be paid. Is it paid? Seldom. Various investigations have shown that the forfeiture of what are called 'good behavior bonds' is rare, and that if they could be collected the city would be some millions of dollars richer. The main reason of it is that the process of forfeiture is cumbersome and uncertain, and for that reason is seldom resorted to. Therefore, bail in these cases is practically an immunity from punishment. Day after day notorious persons who are known to be habitual offenders are arrested and bailed, and go on getting arrested and bailed, so that the bail is really a sham, a farce, and a fraud. It breeds a contempt for laws that is a serious damage to the morals of the community. The magistrates are powerless to prevent it."

• ◆ •

IT may be remembered that after the papers staying Kemmler's death had been served on Warden Durston, a calf was provided as a substitute to illustrate how the electrical apparatus would work. The calf, which was well grown, was placed in position, the full current which was intended for Kemmler was turned on, and the calf was dead in an instant, and according to the story of Dr. McDonald, as related to a *Palladium* reporter, the room was also instantly filled with the odor of burning hair and flesh which quickly drove the occupants out of doors. The electric current, it is said, was on but an instant, but in that time the calf was fairly roasted alive.—*Oswego Palladium.*

• ◆ •

NOT many men retain their ambitions and enthusiasms after forty years of age. They start in life full of determination to reach high positions, but obstacles intervene, and they sit down somewhere to rest and think it over. A good many conclude that it is not worth while to work so hard and get so little, so they fall back and give some one with more sand a chance. That one keeps on and wins. "All things come to him who waits," and those who are watching and waiting are sure of a good deal more than those who sit down hoping for something to fall into their laps.

TRADE NOTES.

JAMES NASMYTH, the celebrated mechanical engineer, and improver of the steam hammer, is dead.

⁂

ALL the machinery and the boilers of the jet propulsion steamer '*Evolution*' are on board that craft, and the work of fitting the machinery goes on every day, but it is hardly likely that she will make a trial trip for several weeks.

⁂

THE directors of the Chicago Board of Trade adopted a memorial to Congress asking that a modern high-class war vessel be substituted for the old steamer '*Michigan*,' the only United States man-of-war on the great lakes. The memorial declares that the '*Michigan*' would excite the ridicule of foreigners visiting the World's Fair.

⁂

THE Amazon crop of rubber, which has just ended, shows a falling off of 5 per cent. in receipts, and the prospects are that the new crop, which will not come in in quantity until October, will be seriously reduced. In consequence of the outlook for extreme prices in raw rubber, the manufacturers will be compelled to make a still further advance in the price of manufactured goods.

⁂

THE Board of Inspection which examined the cruiser '*Baltimore*,' of which board Admiral Kimberly is President, has reported that the vessel did excellent work on her recent trial trip, making sixteen knots under natural draught and eight knots with one boiler and one propeller. The vessel is now coaling at Norfolk, and will leave the bay May 14, for Haytian waters, where she will join the North Atlantic squadron.

⁂

THE Bureau of Construction and Repairs has been searching for a paint that will resist fouling. Trials have been given patent paints generally with unsatisfactory results. The best paint so far found is a composition two-thirds lead and one third zinc. Even this does not stop the growth of barnacles. The '*Cushing*' will receive a coating of a new compound whose inventor asserts that it will give a japanned surface and prevent fouling.

⁂

A. J. Weed & Co., 106 Liberty Street, New York, have placed in their new factory a number of small private workshops, fitted up with lathes and complete outfits of tools in which patrons can experiment and test the practical working of unpatented inventions, etc., in strict confidence. These workshops are rented at very reasonable terms by the day or week. As each workshop is complete in itself and separate from the others, strict privacy is assured.

⁂

THE Lake Erie Boiler Works, Buffalo, is one of the largest marine boiler building concerns in the country, having turned out 59 boilers within the past year, some of them being shipped to Japan. One machine in these works punches eighty-five holes at one stroke. Increased business during the past season has made the enlargement of the plant a necessity, and a furnace room 36 × 96, for heating plates, a hydraulic crane tower building, 50 × 75, and erecting shop 105 × 65 feet, are in process of erection and will be completed during the present month.

⁂

ENGINE No. 871 of the New York Central and Hudson River Road came to grief at the Fiftieth Street bridge, the smoke-stack, bell and dome striking the bridge and being smashed by the contact. No. 871 is the heaviest passenger engine on the Hudson River Division of the road. It was built at the Schenectady works. It has driving wheels 6 feet 6 inches in diameter and weighs 75 tons. So high is the engine that it was found that the dome, even when crushed in, came within 3 inches of the bridge, and the roof of the cab missed it by only about 10 inches.

⁂

THE Providence and Stonington Line closed a contract lately with the Morgan Iron Works, for a 3,500 horse-power compound beam engine, with high-pressure cylinder between the beam center and crank-pin, and the low-pressure cylinder at opposite end, the same as usually placed, making a balanced engine by balancing the forces on either end of the beam, and Sickles cut-off valves on each cylinder; also, three double-ended and two single-end Scotch type of boilers to carry 100 lbs. working pressure. The engine, keelson, and gallows frame are to be of steel.—*Marine Journal.*

⁂

LIGHT, we now learn, not only has sound, but can be heard. A beam of sunlight is made to pass through a prism, so as to produce the solar spectrum. This is turned upon a disk containing colored silk or wool, and as the colored lights of the spectrum fall upon it sounds are given by different parts of the spectrum, and there is silence in other parts. For instance, if the green light flashes upon red worsted, loud sounds will be given. Only feeble sounds are heard when the red and blue parts of the rainbow fall upon the worsteds, and other colors evoke no sound at all. Green silks give sound best in red light. Every kind of material gives more or less sound in different colors, and no sound in others.

THE Pattern Makers' Convention opened at the Ashland House, May 20, with fourteen delegates in attendance. President T. J. McGonnell of Pittsburg called the meeting to order, and P. F. Duchnun of Boston was elected secretary.

The delegates all agreed that there was too much foreign labor imported, and that the pattern makers all over the country felt the effects of the hundreds of cheap workmen who come here from the Old World. An investigation into the matter will be made and resolutions adopted protesting against the crowding out of the American workmen by the foreign element.

On the subject of the limitation of apprentices some little discussion was had, and it is probable that some action will be taken in the matter during the convention.

⁂

AMONG the contracts at present under way at the South Brooklyn Steam Engine Works (successors to Wm. A. Lighthall), builders of surface condensers, etc., we note the following: Two cylindrical brass surface condensers for the U. S cruiser '*Maine*,' each 7,000 sq. ft. of surface. Two cylindrical brass surface condensers for the U. S. cruisers No. 11, each 4,000 sq. ft. of cooling surface; both under contract to N. F. Palmer, Jr. & Co., Quintard Iron Works, also part of surface condenser for U. S. cruisers, Nos. 7 and 8. Two patent combined surface condensers and feed water heaters for Thomson & Houston's Electric Co., Boston. They are also putting on board the Old Colony Steamboat Co.'s new vessel '*Plymouth*' two cylindrical surface condensers, each 4,500 sq. ft. of surface, under contract to the W. & H. Fletcher Co., N. Y., besides a number of smaller condensers under way at their works.

⁂

THE American Ship Windlass Company, of Providence, R. I., built a new steam towing machine. The principle of the machine is that the resistance of the towed barge is borne entirely upon the steam pressure in the cylinders. The wire hawser is wound on a drum, which is driven directly from a pinion on the crank shaft of the engines. The machine is fitted with a reducing valve, which enlarges or decreases the opening as the strain increases or decreases. In a seaway, or when the vessel pays off, increasing the strain on the hawser, the drum begins to revolve, letting out the hawser. This opens the reducing valve and increases the pressure in the cylinder until it is adequate to hold the strain on the hawser. Then, as the strain on the hawser decreases, the pressure in the cylinders revolves the drum in the opposite direction, winding up the hawser. This machine will relieve any sudden strain which may come upon the hawser.

⁂

THE Engineers' Club gave a reception May 20 at their house, 10 West Twenty-ninth Street, to the officers of the army and navy stationed in and about this city. Among the two hundred guests were Admiral Braine, Commodore Loring, Chief Engineers Gowing, Roche, Duncan, Heaton and Wood; Capt. J. N. Miller, Drs. Bloodgood, Gihon, McMurtrie and Bogart; Chaplain Royce, Passed Assistant Engineers Barry and Eldridge, and Assistant Engineers Weaver, Conant and Bennett, of the navy. Mr. Bennett is the young officer who so successfully resisted the tactics of Lawyer Choate at the McCalla trial. There were also Commodore Watkins, of the Inman line, who is commanding the '*City of New York*,' while the '*City of Paris*' is repairing, and Chief Engineer Gearing, of the '*City of New York*.' Gen. Whipple and Col. King, of Willett's Point; Capt. Berglund, Lieuts. Guy Howard, Howe, Flagler, Harding, Darmett and Jcrvy, and Major Randolph, of Fort Hamilton.

⁂

THERE has been a great change in ocean freight rates since the rapid increase of the number of ocean steamers, and generally a steady lowering of rates. It takes, for instance, enormous business to fill up the fleet of steamships owned by the Inman, Cunard, Guion, National, Anchor and White Star lines. The cream of the freight business goes to the fastest ships of each line. The rates paid in the early days of ocean steamships were enormous, and made vast fortunes for the owners. Nineteen years ago, when the White Star Line started with the '*Oceanic*,' the rates were, roughly stated, about three times what they are to-day, although the average time consumed in the ocean voyage was a couple of days longer than it is at present. It is generally true that while on all lines the average length of the voyage has been shortened, the average cost of transporting freight has been cheapened. There is no telling at present what will be the effect of the threatened row between the Inman and White Star lines.

⁂

THE new iron steamship '*City of Seattle*,' built for the Puget Sound and Alaska Steamship Company, was launched May 14, at Neafie & Levy's, Philadelphia. The new vessel is steel, 275 feet in length, 40 feet beam, and 17 feet hold. She registers 1,500 tons. There are three decks, the two upper ones being built of wood. The vessel has a large freight capacity, besides accommodations for 250 passengers. The passenger saloon is on the second deck and is 150 feet long, with staterooms on both sides. The dining-room, which will be situated on the main deck aft, will be finished in hard wood, with nickel mountings. The vessel will carry all the modern improvements and appliances of ocean vessels, including electric lights. She will be supplied with a compound engine, 32 and 60 inches, with 3 feet stroke. There will be two steel boilers, each 13½ feet in diameter by 13 feet long, carrying 145 pounds of steam, and she will have a speed of twenty miles an hour. She will be fully completed by the 1st of August, when she will take her departure on a seventeen-thousand-mile voyage to Seattle.

⁂

THE '*Normannia*,' the new vessel of the Hamburg American Line is 500 feet long, 57' 6" beam, and 8,500 tons burthen. She is a twin screw with 16 000 h.p. She has nine double-ended boilers, with eight furnaces in each, and three funnels, but no forced draught. She is provided with fans to ventilate the stokeholes. The engines are two sets of triple-expansion cylinders with a stroke of 5½ feet. The diameters of the cylinders are 40 inches, 67 inches, and 106 inches. The steam is worked at 160 pounds, and the revolutions at sea will probably be about 85. On some occasions on the trial they made 93. The screws are 18 feet in diameter. The horse-power contracted for was 14,000, with a speed of 19 knots, but over 16,000 horse-power have been indicated, and the coal consumption is not much over a pound and a half per horse-power per hour. There are 16 bulkheads, making 17 water-tight compartments, and there are doorways through only five of the transverse bulkheads. Throughout the whole length of the ship the floor of the vessel has a double skin, and the inner floor is throughout 4 inches above the lower or outer bottom, except in the part under the engines, where the intervening space is 7 feet. There are nineteen of these spaces, so that the hull is sub-divided into thirty-six water-tight compartments. These spaces are largely utilized for water ballast, and controlled by pumps, which are in all cases worked from the main deck, where the donkey engine and the donkey boiler for pumping are also placed. This arrangement of the pumps permits of continuous steam pumping in the event of an accident, such as that which befell the '*City of Paris*,' whose pumps were below the water line, and therefore useless as soon as they were swamped. The nine boilers are placed three abreast, and each triplet is contained in the center of three water-tight compartments. Two of these compartments in each set are coal bunkers, stretching right across the ship, and each set of three boilers communicates by separate steam pipes with both sets of engines.

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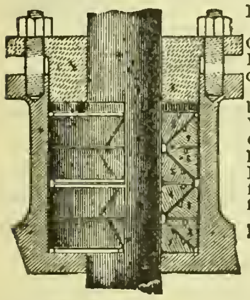

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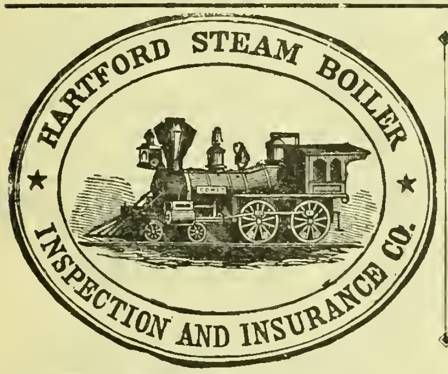

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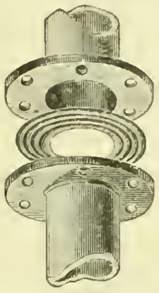

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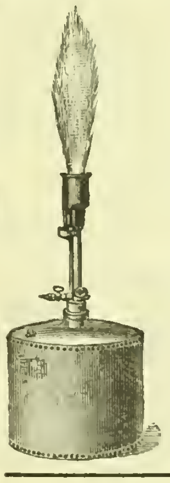

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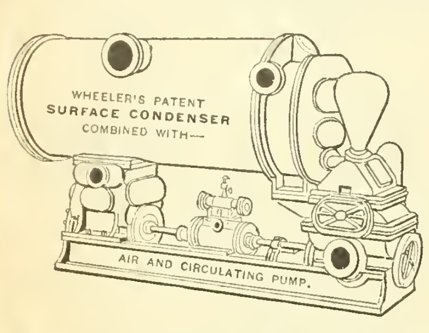

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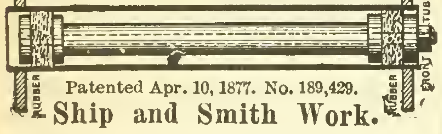

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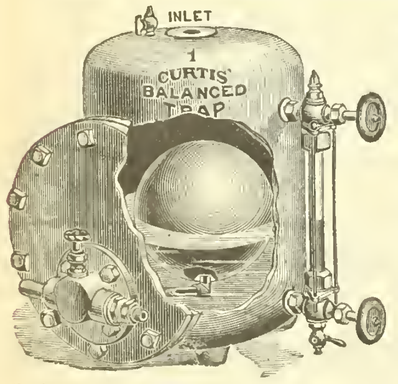

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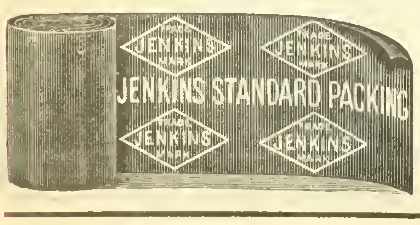

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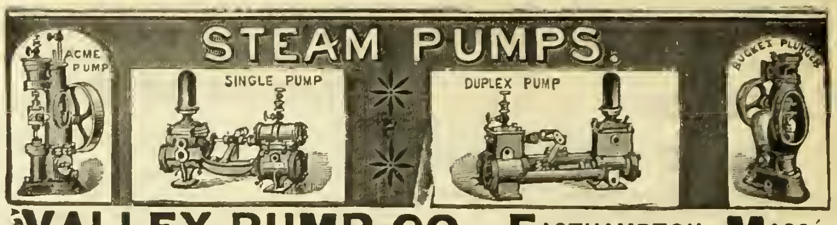

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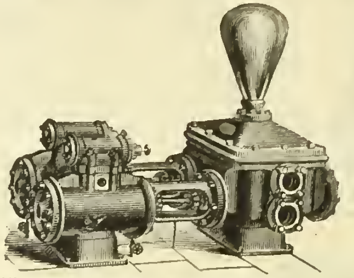

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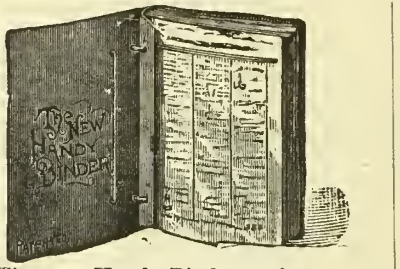

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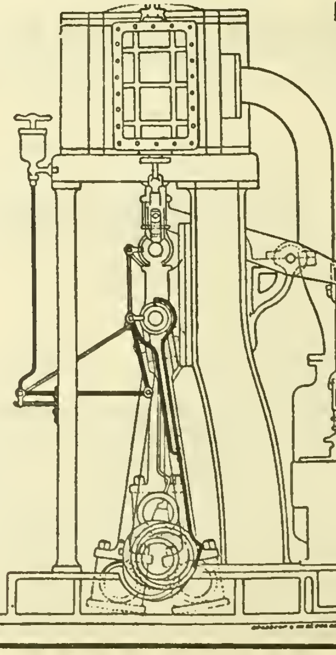

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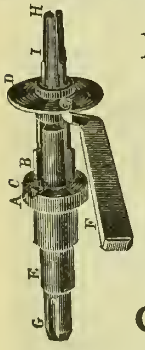

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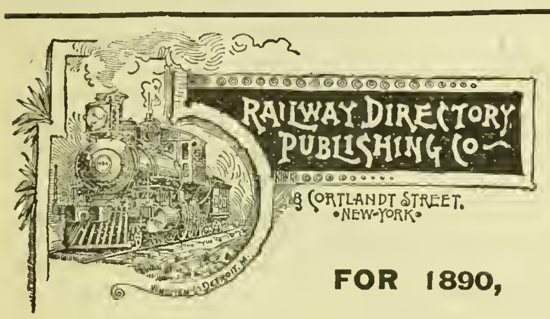
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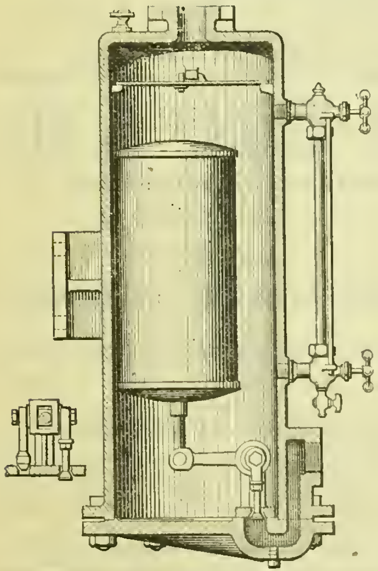

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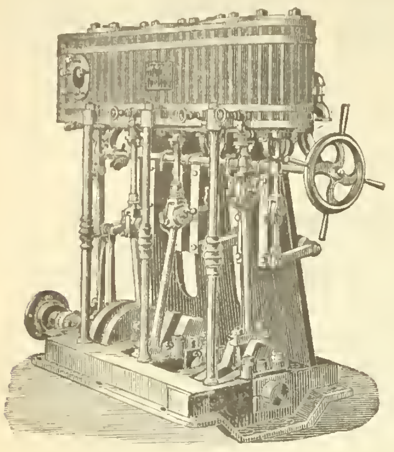

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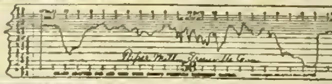

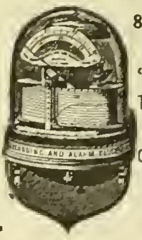

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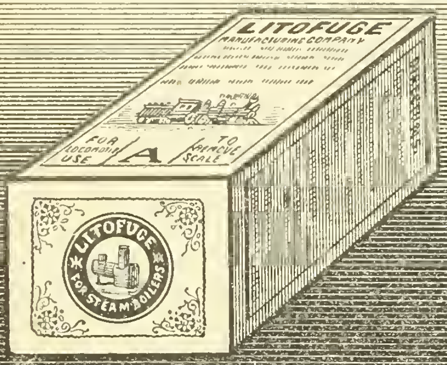

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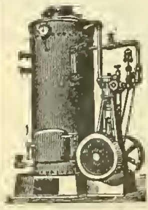

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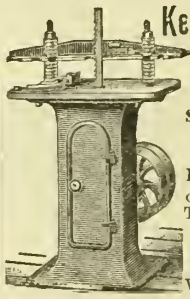

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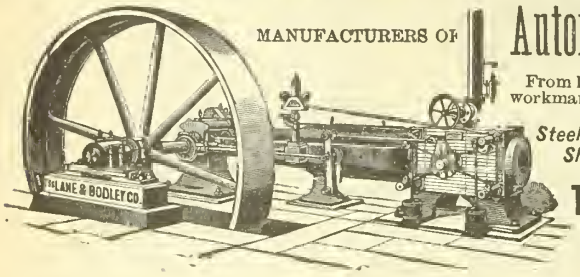
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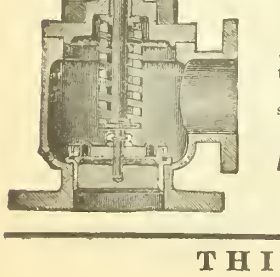

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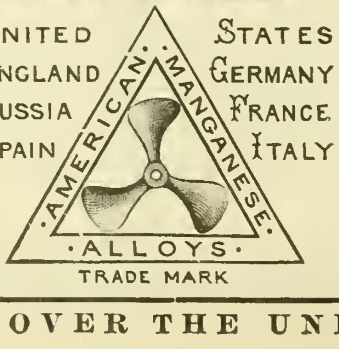

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TENTH YEAR OF PUBLICATION.
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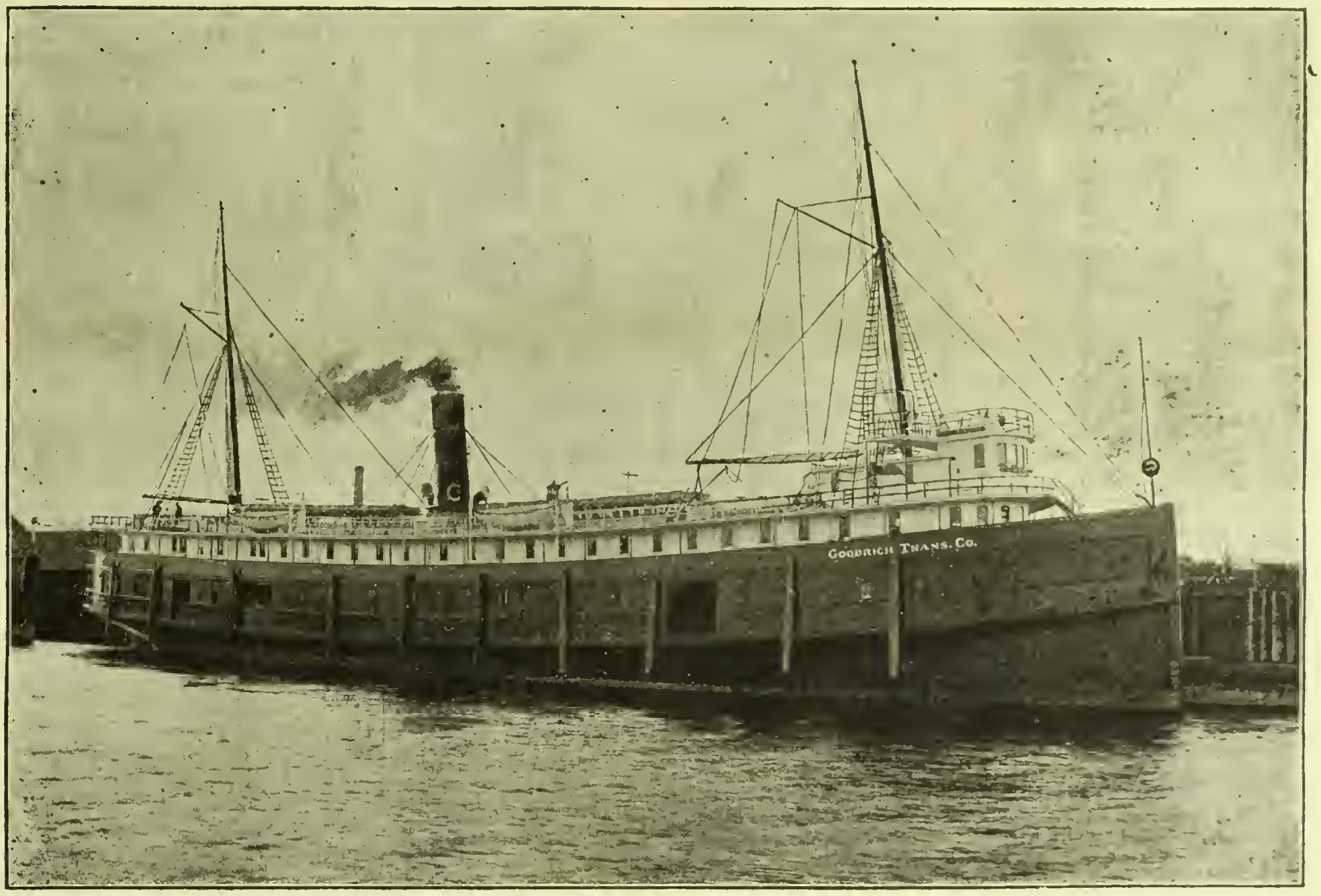
$2.00 PER ANNUM. - SINGLE COPIES, 8 CENTS.
June 7, 1890.

THE 'CITY OF RACINE.'

OF THE GOODRICH TRANSPORTATION COMPANY'S LINE, MILWAUKEE, WIS.

THE engraving represents a vessel just completed—one of two—by the above company for their passenger service. She is handsomely fitted up for this traffic,and can accommodate about 500 passengers, including berths for same.

The vessel is 200 ft. keel, 220′ over all, by 35′ beam, and 12½′ depth of hold. The engines are by Charles F. Elmes & Co., Chicago, and are compound with cranks at right angles. The cylinders are $\frac{28+50}{36}$ with bar link-motion, and riding cut-off valves. The air pump is worked by the main engines (from l.p. crosshead), and the engines are easily handled by steam reverse gear. The type of engine is the column frame, these latter being 7″ wrought-iron six in number. The shafts are 11″ diameter and crank-pins 11¼. The wheel is 10′ 6″ diameter by 11′ pitch. There are two boilers with two 30″ furnaces in each and 116 four-inch return tubes. The boilers are 9′ diameter by 16′ long, and of $\frac{9}{16}$ths Otis steel, drilled holes, hydraulic riveted, to carry steam at 120 lbs. working pressure. On a recent trial trip the performance of the vessel and engines was very satisfactory. The speed attained with 100 revolutions per minute and 100 lbs. steam, 10″ cut-off, was 14 miles per hour, and the vessel can do better with higher pressure. With 115 pounds pressure, and correspondingly increased revolutions, she can make 16 miles per hour—through the water. As this last may seem a superfluous remark to some who are not nautical, we will explain that it means unaided by wind, tide, or current. We are under obligations to W. E. Elliott, Supt. Engineer, for the details and photograph.



◆

A TEST of metallic cylinders for holding oxygen was lately made at Glasgow. The cylinders were of ¼ inch steel, 6½ ft. long, 5½ in. diameter, weight 107 lbs. They had been subjected twice to the ordinary test pressure of 3,600 lbs. to the square inch, the practice being to make them more than twice as strong as the normal pressure to which they are regularly charged with the gas, namely, 1,800 lbs. to the inch. The test in this instance was to try the strength of the cylinders in respect to indentation, breakage by falling, etc. Dropped from a height of 35 ft. upon iron blocks, the cylinders were only slightly indented. Weights of 600 lbs., dropped from a height of 35 ft. in the center of the cylinder, which was supported at the ends, bent and flattened the cylinder somewhat, but caused no leakage of the high pressure gas. For all this one of them burst mysteriously and killed the man carrying it.

◆

BY electric welding,shells instead of being made of cast-iron and boxed as formerly, are made by welding a chilled point and butt to a section of soft iron pipe, and, in the case of shrapnel shells, the trouble of graduating the thickness with calipers, after boring and adjusting the delicately poised diaphragm between the powder and the bullets, is greatly diminished.

THE largest gun ever made at the Krupp Works is of cast steel, and weighs 270,000 pounds, or 120 tons. Its calibre is 16¼ inches, and its barrel is 44 feet long. The core was removed in one piece. The range of the gun is twelve miles, firing two shots per minute, and each shot is estimated to cost £300. At the trial the projectile, four feet long, weighing 2,600 pounds, propelled by a charge of 700 pounds of powder, penetrated a nineteen inch armor and went 1,312 yards beyond the target.

◆

HON. F. W. WHEELER, with regard to talk of a sale of his West Bay City shipyard to Englishmen, said, "I have reached the conclusion that any business enterprise that would be good for an English syndicate will be good for me. The only way to make anything out of a syndicate is on the basis of fancy prices, and that sort of business is certain to react eventually and cause serious trouble for all concerned."

◆

IN regard to the relative efficiencies of water-jet propulsion and screws for vessels, some exhaustive experiments were tried by Thornycroft in England, in 1883. The result was as 72 to 169 for the screw. Perhaps Mr. Jackson has made some discoveries since then which will make his yacht '*Evolution*' evolute, but we fear he hasn't.

◆

THE officers' salaries of the Chicago Exposition have been fixed. The president is to receive $6,000 annually ; vice-president, $12,000 ; treasurer, $5,000 ; and auditor, $5,000.

There are 2,000 engines on the Northwestern Railway of England that will take the same boiler. A change of boiler from one engine frame to another can be made by taking out only eighteen bolts. The list of compound locomotives in this country now includes the ten-wheel engine of the Michigan Central Railroad, Mallet system: the eight-wheel engine of the Baltimore and Ohio Railroad, with four cylinders; the English engine of the Pennsylvania Railroad, Webb system, with three cylinders; a new passenger engine being built at the Altoona Works of the Pennsylvania Railroad; a passenger engine for the Old Colony Railroad, Mallet system; and the three new engines for the East Tennessee, Virginia and Georgia Railway. The Mexican Central Railway is having a compound engine built; and the Grand Trunk Railway of Canada has one or more compounds. In addition to these, Mr. George S. Strong, the inventor of the Strong locomotive, has patented designs for the application of 'the compound system to his engines. The new Pennsylvania Railroad engine will be on the Mallet system, with cylinders 19 in. by 24 in. and 27 in. by 24 in., and driving wheels 68 in. diam.

◆

In the early summer the vanilla plant bears a beautiful white flower, which grows in clusters, like the lilac, and from this the plant is propagated, and the growth and development of the bean then follows. When ripe, the bean is a large green pod, resembling the banana. When first taken from the vine it is often from two to three inches in circumference, but, when cured, it is shriveled and nearly the size of a pipe stem When the weather is clear these beans are placed in rows on mats to dry, and are taken in in the evening, and are placed in caldrons and covered with blankets, where they go through the sweating process at night. At this time a vegetable oil oozes from the bean, which is carefully collected and preserved for future use, when the beans are being bundled. They continue to go through this process of sweating and drying until the proper color and flavor is developed. As soon as the beans are sufficiently cured they are sorted in lengths, bundled and packed in tins, which are then shipped to market. The bundles are made up by men who have become dexterous in handling them, and the oil which is collected from the sweating process is then used, each bean being rubbed separately with the oil, so that the bundling, as well as the care and time required in their curing, is very tedious.

◆

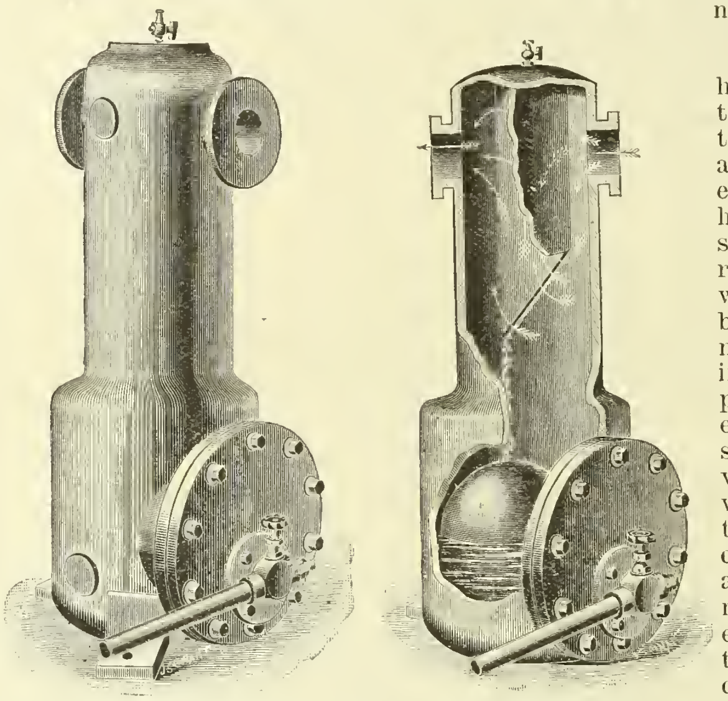
No organizations in the United States have multiplied more rapidly in the past ten years than the sick-benefit, funeral aid, death-benefit, and other kindred societies. As they are generally confined to those in the humbler walks of life, the good they have done is incalculable, carrying substantial aid to thousands of stricken families, and inspiring those who are fortunate enough in being members with a courage which might not exist in their hearts without them. The members of these organizations will be glad to learn that Hon. Robert P. Porter, Superintendent of the Eleventh Census, will endeavor to secure the statistics of the noble work these associations are doing, and it is safe to say that no other branch of the census will be more interesting. The business of gathering the data has been placed in charge of Mr. Charles A. Jenney, special agent of the insurance division, 58 William Street, New York City, and all associations throughout the United States, whether incorporated or private, should assist by sending to him the address of their principal officers.

◆

Fairbairn claims to have introduced twin furnaces and alternate firing of the same, as a means of preventing smoke from steam boilers.

THE CURTIS SEPARATOR AND TRAP.

Within a few years past a new class of appliances for steam boilers have come into use, which add much to the efficiency and economy of both engines and boilers. It is hardly necessary to say that engines are intended to use steam only, not a mixture of steam and water, but this last is frequently met with in many places, particularly where boilers are forced or where from defective design they prime. It is not always the dirty boiler that does this, but it is annoying and expensive, whatever the cause. Steam which is partly water is reduced in volume and is deprived of its elastic force from this cause, and also from the fact that less steam gets into the engine. In all cases the supply of steam is fixed by the valve-gear naturally; if part of this supply is water the engine does less work. The apparatus shown herewith is intended to remove all water in the steam by whatever cause produced. This it does by the method shown in the sectional engraving, where it is seen that the steam in passing from the engine is deflected from a direct course by a diaphragm, placed at right angles to it, and against which it directly impinges. The shock of impact literally knocks the water out of the steam, and the latter, freed from its enemy, goes on its way very much benefitted by the collision. The separated water remains behind instead of following the current, the diaphragm being so made that the water runs down the side of the chamber instead of remaining in the current where it can be carried over. The water at the bottom of the casing is removed by the Curtis steam trap, which has patent balanced doubled-seated valves of large area operated by the float shown. This last is cast of composition, and is perfectly round; it is of the ventilated type, having a hollow stem through which air circulates and fills the interior of the globe, creating a pressure internally, and insuring it against filling with water. This apparatus as a whole is also quite as useful on the exhaust side, as it effectually arrests the grease with which all exhaust steam is more or less charged. In apartment houses and large office buildings this apparatus is a prime necessity, for, unless checked in the manner shown, the radiators quickly become fouled from the cause stated. The apparatus is made by the Curtis Regulator Company, Boston, Mass.



◆

Some of the new freight boats on the Great Lakes make nearly 16 miles an hour. That is as good as the average freight train on railways. Much better, in fact, for the boats never lay up on side tracks.

◆

Mr. George H. Strong is not fortunate in the name of his patent locomotive, for it is always alluded to in press dispatches as a strong engine.

CURE FOR SEASICKNESS.

Charles W. Hamilton, a naval surgeon, publishes this plan for curing seasickness: "The successful treatment of seasickness, which surgeons afloat have so much to do with, and which generally they are unable effectively to alleviate, must prove my excuse for bringing before the profession the curative effect of kola (*Sterculia acuminata*). In the few cases which I have lately had to deal with I have found the internal administration of the seed of the kola a most successful remedy. Half to one drachm of the seed chewed slowly was followed, in about forty minutes, by complete cessation of the various symptoms of *mal de mer;* the depression, vomiting, and giddiness disappeared; the heart's action was regulated and strengthened, and a confidence was felt in heavy weather that my cases never before experienced during the many years that they served in the Royal Navy, and had tried the usual remedies prescribed by their advisers. At present no means of preventing seasickness in those susceptible of it is known; and I venture to believe that in the kola, or its alkaloid, we have one, and that a larger trial of this drug will tend to support my opinion."

There is only one sure cure for seasickness in some persons—don't go to sea.

◆

Queer notions people get into their heads at times! At a late meeting of the *Inst. Mech. Engineers*, of England, the president said: In regard to triple and quadruple expansion engines generally, he mentioned the necessity of having an equal load on each crank seemed to be overlooked by most marine engineers. The effect of such a want of equality on a locomotive would be to throw it off the line and almost make it turn a somersault, and arguing by inference a large amount of power must be wasted in a marine engine in counteracting and withstanding these strains. If a reducing valve or some other throttling device were placed in the receivers between the cylinders, the work of each cylinder could be equalized, and the objectionable strains avoided. As regards locomotives running off the rail from unequal power, it is very common for them to use one side only when broken down on the other. They do not run off either.

◆

There is a growing tendency, especially in this country and in England, to "set engines up on end," and, considering how precedent is the other way for stationary engines, excepting the beam type, we may reasonably look for a still wider adoption of the vertical plan. There are a great many reasons in favor of vertical engines, and very few objections to them. Marine "steeple" practice has been so successful that mill builders have turned their attention that way. There are a number of cotton mills in England that have been fitted with vertical engines in the last few years, and in this country a fair proportion of rolling mills, factories and other plants are thus arranged, especially for large powers.—*Industry.*

◆

To illustrate the necessity of air as a component of combustion, Faraday employed this experiment: He saturated cotton wool with any hydrocarbon liquid and set it on fire in a jar of oxygen. The hydrogen in the hydrocarbon attacked the oxygen, burning with a brilliant flame, gradually decreasing as the supply of oxygen grew less; when, suddenly, the cotton wool threw out a dense mass of soot and black flakes in surprising quantities, completely filling the jar. This is exactly what occurs in the furnace of a boiler when combustion is imperfect.

◆

The greatest possible pressure produced by exploding a mixture of 7 volumes of air to 1 of gas, was 89 pounds per square inch above the atmosphere.

EARLY DAYS OF RAILWAYS.

An English engineer recently related the following concerning the early English railways and locomotives:

All the engines up to and including the Swift built in 1836 or thereabouts, had only two eccentrics, which of course necessitated hand-working to start in either direction. This of itself required a practiced hand to do, and would bother nearly every engine-man of to-day. There was no brake of any kind on engine or tenders, and the only way of controling the trains down grades was to put the engine out of gear, or for the fireman to drop off the engine, and let down as many wagon brakes as he thought necessary; and when they had to be taken off, he had to repeat the operation of getting off and lifting them, he then getting on the last wagon on which the brake had been down, and walking along the top of the coal back to his engine.

In my early days the engines were run by contract by the driver, who found coal, oil, and every requisite, and was paid by ton of coal moved. The driver had two men in his pay, one a "driver-fireman" and the other a "fireman." The steam was got up on Sunday night by the fireman; and the driver and he ran the first train on Monday morning. On the return in about eight or nine hours, the fireman went home, and the driver with his "driver-fireman" ran the second trip; and on the completion of the second trip the "driver" went home, and the "driver-fireman" took charge, and the "fireman" who had been resting resumed duty, and this system was followed day after day. The other duties of these men was somewhat as follows: On the return after a trip the engine was taken to the coal depot, and coaled with a shovel by the men themselves ready for the next trip. If traffic was plentiful the stay was short, and after a meal the engine was off again. There was no time-table. After going about a mile from town all the wagons had to be oiled, as there were no grease boxes; the engine was slowed down on the level to about three or four miles an hour, and the two men got down, one on each side, with his oil-can and a stick about three feet long, at the end of which a piece of oakum was tied, and with this the underside of each journal running in a cast-iron block was carefully oiled. After all were done, they got on the top of the last loaded wagon, walked back to the engine, and away they went. This was repeated after about twelve miles, going in both directions. There was no guard and no brake-van, and all depended on themselves. As there was no van, it was necessary in the day time to put a board up on the last wagon, so as to be sure they had not lost any of the train. At night a large pan of fire was affixed to the front of the tender and to the last wagon for the same purpose, and it was the duty of the fireman to keep both alight. There were no signals and no switchmen, each man taking care of himself and his train, and keeping out of the way of the few passenger trains run.

No passenger trains were run on Sundays, except between Darlington and Stockton once each way, worked by a horse. The carriage was on four wheels without springs, and was made to carry six inside and fourteen outside, including the coachman. It was like an old ordinary road stage coach with two front ends. The ordinary passenger trains on week days had one first class with three bodies, which could carry eighteen passengers, and one second class, also with three bodies, which could carry twenty-four passengers. The speed, including stoppages, averaged, say 16 miles per hour for the journey of 24 miles.

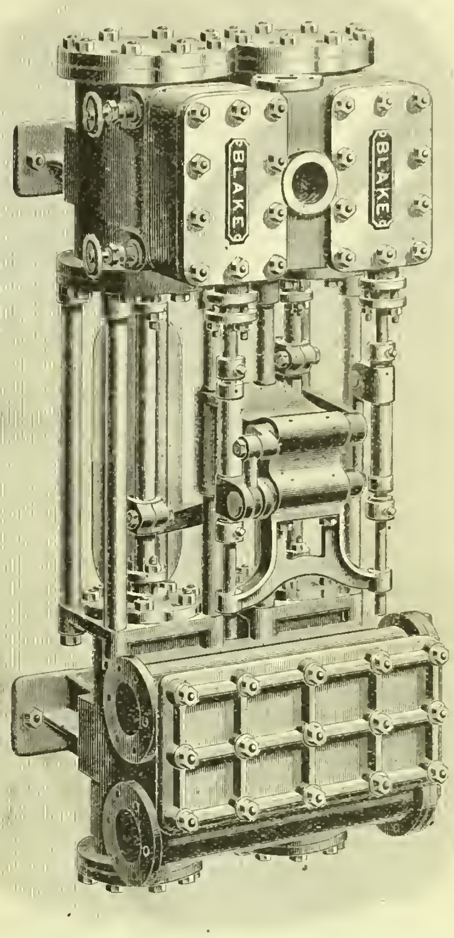
◆

Hall's first surface condensers (1831-1838) reversed the present system; the exhaust steam entered the tubes, instead of the water circulating through them. Since Hall's day the improvements have been many.

BLAKE'S VERTICAL, DUPLEX, MARINE PUMP.

The engraving represents a new design of marine pump lately introduced by the Blake Manufacturing Co, of New York and Boston, for all purposes on shipboard where pumps are used. As will be seen, it occupies very little space, and can be put in very contracted quarters. At the same time it is accessible in all parts. The valves—both steam and water—are in direct sight, so to speak, and are of the type usually employed by the company.

The water end is of the double-acting piston pattern, composition-lined pump cylinders, and the water pistons are of composition, provided with adjustable fibrous packing. The piston-rods, stuffing boxes, valve-seats, valve-bolts, etc., are also of composition. For naval use the water end of the pump is usually made *entirely* of composition, which, although adding somewhat to the cost, makes it a much lighter and more durable machine. The water passages and valve area are made unusually large, thus permitting of a high rate of speed—an important advantage in case of fire or other emergencies. The water valves and the packing of the water pistons are very accessible and easily renewed. The steam cylinders are provided with an improved form of valve gear made of steel, with provision for ready adjustment while the pump is in operation.



These pumps are carefully tested to 300 lbs. pressure per square inch, and thoroughly inspected before shipment.

They are largely used by the British Admiralty and other foreign powers.

◆

Occasionally we receive letters from friends who operate stationary plants saying that they would like to see more about stationary engines in this paper. In reply to this we have to say that the principles of steam engineering are the same, no matter whether the plant is afloat or on shore. It makes no difference whether an engine is vertical or horizontal so far as its action is concerned; whatever applies to one applies to the other. Another point about this matter is that more marine engineers write to us than stationary engineers, and we naturally incline to consider those who favor us with their views. The Engineer is not addressed to any particular class of engineers, but to all classes.

We often meet with machines that require from ten to twelve horse, furnished with a driving pulley about twelve inches in diameter and six-inch face. In order to run such machines under the most favorable conditions, without any allowance for the extra power required in starting, the belt must be constantly subjected to a standing tension of not less than two hundred pounds to the inch in width, and the constant slipping over the face of the pulley generates heat, that materially helps to destroy the fibers of the leather, which are already subjected to a strain beyond the power of endurance. No wonder such belts are constantly breaking, and new ones are so often required to take their place. Whenever a belt is sufficiently tight, and persists in slipping when the work of the machine is slightly increased, it is sufficient evidence that it is deficient in belt power, and it is much cheaper in the end to replace the driving-pulley with one of wider face, if the circumstances are such that the diameter cannot be increased so as to admit of a wider belt, than to go on purchasing new belts every two or three months, without taking into consideration the time lost in patching and mending old ones.—*C. R. Tompkins.*

◆

A concern which makes a business of furnishing "selections" to papers for a stated sum sends us these samples, which they think will interest our readers:

Japanese chickens, with tails from eleven to thirteen feet long, are being imported into this country.

The appearance of the guards' sentries in London, armed with the new magazine rifle and short sword bayonet, excites much conversation among military men.

The ancient Greeks used olive leaves for ballots, and the Australian voting system is a revival of the practice in Rome two thousand years ago.

Paris cab fares will no longer be a franc and a half for all distances, but the distance is to be accurately measured by an apparatus in the cab, and the charge is to be seventy-five cents for the first kilometer and twenty-five cents per kilometer for any further distance.

Thanks! don't send any more.

◆

Not the least instructive feature of the meetings of engineers is the variation in practice, and in the cure of diseases steam engines are liable to. It would hardly seem possible that there could be so much difference as there is, but it is not at all uncommon to find men of experience at opposite poles upon the same subject, and both confident of their correctness. It is quite possible that both are right, for there are various ways of doing the same thing. Another feature of these meetings is that some members assert their disbelief in certain standard methods without ever having tried any experiments to prove or disprove their positions, but basing their views upon a hasty impression or conclusion. John Smith says he does not believe there is any value in steam jackets, for such and such reasons, when it is a well-established fact that under some conditions great economy has been shown by them. Sometimes it is wise to hedge a little, as sporting men say, on engineering subjects.

◆

"If I had the hiring of a million workers, I would try to find out which of them were agitators, orators, socialists, anarchists, and talkative cranks in general, and I would pay them a salary to remain away from my shops rather than have them around talking my plant, my other employees, and my business to death. Some inventor ought to bring out a patented talk squelcher."—*Unknown Solon.*

◆

When the amateur takes to timing, the case is hopeless; fractions are ignored as beneath notice, and the result is generally extraordinary. In railroad timing, a mistake of the fraction of a second at high speeds makes the record leap at one bound from the probable to the impossible. One-fifth of a second seems a minute quantity, but it will turn $77\frac{3}{5}$ miles into eighty miles per hour.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

TAKE THE BULL BY THE HORNS.

Editors ENGINEER:

In looking over THE ENGINEER, No. 11, I see that No. 13 M. E. B. A., have followed up their good work, but, as they say, there is plenty more work to do, and you need not go to Philadelphia to find it. Here in Connecticut there is plenty of work. Right in sight of where I am sitting at the present time is a boat running with an engineer who never served any time in an engine room, or as a fireman. In one application that he got out he stated that he had helped the engineer to pipe off one boat. I do not know what they gave the license on, but presume in the special license clause; but, if I remember right, that applies to small pleasure steamers only, and, if I have been informed correctly, this license is a good ways above that.

There is another case in Bridgeport, Conn. A colored man has a license and is running a towboat, who served his time firing a cook stove in the galley and chasing lines around the deck. The boat has not carried any fireman for two or three years to my certain knowledge.

Another case is of a man who was born in Canada. They tell me he was "temporarily born" there. Perhaps you know what that means, but I must confess that I do not.

Also, there is a case for the Pilot Association to look after. A man served his time on an oyster sloop, went to the Inspector's and got a license for 100 tons boat; he said he told the Inspectors of more rocks than they knew of themselves, and I guess he did, for he can find them pretty well from all accounts. There are men that should look after these things, and they could get all necessary proof with very little trouble, but something has taken the stand-up grit out of them. Guess it must be the mild winter.

Some tell me that it does not make any difference now who signs an application, or whether they know anything about the applicant or not; but I do not know of any such changes in the license laws. I will stop, for some will say I am a crank; but Brother Watson let us keep the crank turning until we grind out justice to the marine engineer.

Connecticut. ZEKE.

[Take the bull by the horns; that is the way to down him. Let every man who knows of such cases as those named above go to his Association and demand that they tackle the matter at once. Any Association who does not, with full knowledge in the premises, has no cause to complain if its members are idle, while those not duly qualified have work. The remedy is in their own hands. Let them go to the Inspector, and lodge a complaint, and if he does not attend to it, forward the same to James A. Dumont, Supervising Inspector General, at Washington; he will see that justice is done in the premises. If local inspectors would take a little trouble, and satisfy themselves in cases of doubt that any applicant is qualified, as they could readily in small places, they would save themselves and engineers much trouble in future. Too often inspectors think they will offend some vessel owner by not giving them the benefit of a doubt where they send men to be examined, but this is a question of duty to the public, not to vessel owners, and discriminating in favor of them is wrong to all concerned.—EDS.]

◆

IT seems natural for a person who has not acquired skill in any operation to marvel at the ease with which another does something that appears difficult to perform. Looking on admiringly, and wishing that we could perform operations requiring acquired dexterity, is useless. What one can do another can learn, if he is persevering enough to go through the training necessary. The difference between easy and difficult work was one day strikingly explained by the chief draughtsman of the Edison works at Schenectady. A graduate of a technical school, who had been hired to do some drawing, went to the man in charge and asked if the work was difficult. "Well, young man," replied the chief, "if you don't know how to do it it is difficult." The same thing applies to all work entailing developed skill.—*National Car Builder.*

◆

A GENTLEMAN has been at much pains to invent an instrument for measuring the heat radiated by the moon; he ascertains that it equals that given out by a candle twenty-five feet off. This seems to be a case of time wasted, for there is no way in which the information can be made useful.

PITTING OF IRON.

ANY wrought-iron vessel which holds water is liable to suffer from pitting, whether the same be open to the air or closed from it. We have knowledge of a small wrought-iron tank which holds four or five gallons possibly. This tank stands on a range, and is constantly hot. Nothing but ordinary city water ever touches it. It is open to the air, but it is always full of water. Gradually the walls below the water line at about three inches from the bottom have been pitted all the way around, and small holes, about $\frac{1}{8}$ of an inch diameter, have been eaten through. This is pitting, pure and simple, and it has puzzled a great many wise men, who have made all sorts of conjectures as to the cause of it when found in steam boilers, and in their flues. It seems to have been taken for granted that it is peculiar to steam boilers; but this is erroneous, we think, for the same phenomena may be found in all wrought-iron structures at one time or another. It is found in steel as well. Cutlery will in time become pitted with spots of rust no larger than a pin's head, which will be found to extend much below the surface. Saws are also included; in short, anything made of iron or steel is liable to the disease, if that term may be applied to it. What causes it is another branch of the subject to which we cannot give a satisfactory answer. Natural deterioration seems plausible, just in the same way that timber rots. Wherever the air has free access to clean iron surfaces, pitting, or in other words rusting, is certain to occur at longer or shorter periods, and the only way to prevent it is to keep the surfaces covered with some air tight pigment where it is possible.

◆

ENGINE TESTS.

THE so-called testing of an engine and boiler is not the easiest thing to do correctly, unless an honest purpose is a part of the motive. Men who mean to do just right are so often prejudiced in wanting to accomplish some especial result that they become dishonest in action by being *biased.* The man who searches for the fact must have judicial impartiality, more than judicial fairness, in hearing, by observing, recording and computing facts only, and with all corrections carefully included, for few of the material substances of this earth are constant in value, because subject to physical changes by heat and cold, or friction, etc. Frequently the self-interest comes in in the way of using a particular grate-bar, gauge-cock, steam-gauge, indicator, or some other fixture or accessory, and then again we must learn to use these matters correctly, for very frequent instances of a lack of knowledge or disposition to properly apply an instrument come to the knowledge of the observer of facts. In short, a man, to attempt a test, must be honest with himself, must disabuse himself of all preconceived ideas, and submit himself simply as a medium of measuring, weighing, counting and recording, in order to compute afterwards and render honest account of results, without one particle of personal wish, favor or prejudice entering into the problem or results.—*Pray.*

◆

REV. O. P. GIFFORD, of Boston, in a recent sermon on "Woman's Work," is reported as saying: "The great shame of our present civilization is that we do not pay women the same wages that we pay men for the same work equally well performed. This thought should come with special force to the Christian man. It is outrageous for employers to pay women five dollars and pocket the other five dollars, and then chuckle all the way home because they have got a man's work done equally well by a woman for five dollars less than they would have to pay the man. Women are entitled to an equal standing with men in commercial and social life."

◆

THE '*Aller,*' on a recent trip to this port, took all the bolts out of one shaft coupling by racing of the engines.

LOCOMOTIVE FIREMEN.

A YOUTH entirely unacquainted with all the operations which a fireman is called upon to perform finds the first trip a terribly arduous ordeal, even with some previous experience of railroad work. When his first trip introduces him to the locomotive and to railroad life at the same time, the day is certain to be a record of personal tribulation. To ride for ten or twelve hours on an engine for the first time, standing on one's feet and subject to the shaky motion, is intensely tiresome, even if a man has no work to do. But when he has to ride during that period, and in addition has to shovel six or eight tons of coal, most of which has to be handled twice, the job proves no sinecure. Then the posture of his body while doing work is new, he is expected and required to pitch coal upon certain exact spots, through a small door, while the engine is swinging about so that he can scarcely keep his feet; his hands get blistered with the shovel and his eyes grow dazzled from the resplendent light of the fire. Then come the additional side duties of taking water, shaking the grates, cleaning the ash pan, to even the fire, where bad coal is used, filling oil cans and trimming lamps, to say nothing of polishing and and keeping things clean and tidy. By the time all these duties are attended to, the young fireman does not find a great deal of leisure to admire the passing scenery.

A great many idle young fellows, ignorant of railroad affairs, imagine that a fireman's principal work consists in ringing the bell and showing himself off conspicuously in coming into stations. They look upon the business as being of the heroic kind, and strive to get taken on as firemen. If a youth of this kind happens to succeed and starts out on a run of 150 miles with every car a heavy engine will pull stuck on behind, his visions of having reached something easy are quickly dispelled.—*Angus Sinclair.*

◆

THE first steam engine that Nasmyth ever made was a small one for grinding colors for his father's use, in the days when the "artist's colorman" did not do so much for his patrons as he does now, and when moist colors in tubes were unknown. When the engine was set to work, which would be about 1827, he was annoyed to find that it moved by jerks every now and then, and upon examination he discovered that they proceeded from the priming of the boiler. He then turned the steam pipe through the hottest part of the side flue of the boiler, and thenceforward the trouble was at an end. Nasmyth claims this as the first practical application of the superheater. There was shown in the American section of the Paris Exhibition of 1878 a flexible shaft, invented by a certain Mr. Stow. It also made its appearance as a new thing some years before for actuating a horse clipper, and it is now in everyday use by dentists for working their drills. It was, however, invented by Nasmyth in 1829, for executing a difficult job in drilling with which he was entrusted by Maudslay.

◆

"WHEN brass mountings to furniture become tarnished, they may have their brilliance renewed by first rubbing them with a strong lye of wood ashes, then pickling them in diluted aqua fortis strong enough to remove the defacements, and washing them immediately afterwards in cold water. The last process is to dry them by artificial heat."

The above is cut from an art magazine which instructs ladies "how to make home beautiful." We add to the directions that it is cheaper to throw the brass mountings away and buy new ones than to fuss with the old ones.

◆

IN a hundred years the United States has spent $93,000,000 on a lighthouse establishment. During this year the amount expended will be $3,500,000.

THE JUSTIN DYNAMITE SHELL.

THIS shell, which is to be fired from an ordinary gun by a powder charge, is thus constructed. It is a combination of two shells, one suspended within the other. The outer one is of cast-steel, tubular in form, and provided with a breechpiece. The inner cylinder is ordinary wrought-brass tubing, one-half the length of the outer shell, and having a thin steel cap fitted at either end. It has no metallic connection with the outer one, elastic washers being employed to prevent such contact. Within the inside cylinder, and fitting close to it, are wooden boxes containing dynamite, the number varying according to the quantity of the explosive it may be desired to use. The boxes communicate with each other by means of central openings. When the boxes of dynamite are in place the steel caps of the brass cylinder are screwed on. These caps are furnished with leather air cups, one on each end, in each of which is a vent through which the air in the head of the shell slowly escapes, allowing the tube containing the dynamite to run slowly down to the point, where it is held in place by a small steel wire fastened over a sharpened bearing. This leaves the rear half of the outer shell entirely empty, save air. When the shell receives the impetus of the firing charge of the cannon the wire is instantly broken, and the inner shell should, according to the inventor's theory, go unexploded to the rear. It did not do so in a recent trial. The air in the back chamber forming an air cushion, being displaced through the vents in the leather air cups, should then rush to the space left in the forward end by the inner shell as it works backward. The fact that the inner shell is free to move backward and forward slowly, and is supposed not to be subject to shocks caused by explosion of the powder behind it, through entire absence of metallic connection, is the secret of the alleged non-explosion of the dynamite. The point of the shell, though heavily weighted to insure a perfect balance when the cylinder containing the dynamite is at the rear, is of very thin metal, and is easily broken when it strikes any resisting surface. The collapse of the head explodes the dynamite. The recent accident referred to elsewhere is supposed to have been caused by failure of the shell itself.

◆

WHO are these in dark array who throng the benches in the city parks on pleasant days? They are stragglers from the great army of the unemployed who sit down awhile. Early in the morning or late at night, it is always the same, and a more apathetic, listless set it would be hard to find. Dejection and despair are written on every countenance, and there are any quantity of them. In a great city there must necessarily be large numbers of idle persons, and a stroll through only one or two parks reveals the fact that there is an astonishing number. They must eat at sometime and sleep somewhere, and how they contrive to obtain the necessaries of life is one of the mysteries of it.

◆

"Now that H.B.Claflin has started it," said a well-known stock operator lately, "we shall undoubtedly have a regular rush of firms consolidating their business on a stock company basis. The boom began in England with the Guinness brewery precisely as the H. B. Claflin Company started it here. A craze set in, and now the stockholders are appealing to the courts and climbing out of the small commercial companies with as much fervor as they got in. The success of nearly all of these big dry goods houses, breweries and manufactories can be traced to one man's brains. If the stockholders leave the right man in control they are all right, but in nine cases out of ten the schemers and revolutionists get hold of the majority of the stock, and the brainy man of the concern is driven out. Then the step of the lawyer is heard coming up the stairs."

THE DEVELOPMENT OF THE CALIPER.

To definitely ascertain when the first piece of mechanical work requiring accurate gauging or measurement was executed, is as difficult as would be the task of settling the date of the deposit of the metals and their ores among the rocks. It is certain that the working of metals is a very ancient art. Some of the ancient work proves the early existence of tools which were at least as effective if not equal in all respects to such as the modern mechanic requires.

Tubal Cain is the first name mentioned in connection with this subject. He is reputed as a skillful workman, and while he may have made many measurements by touch and sight, he must have had certain tools to aid him in securing accurate results.

Without doubt, the first tool that suggested itself to the mind of this early worker for the measurement of diameters or thicknesses, was a gauge something like that shown in Fig. 1, which is simply a notched plate of iron, the width of the notch being the measurement of the diameter or thickness required, and by repeated applications of this gauge to the work as it neared completion, accurate results were secured; but this tool was what would now be called a special tool or gauge designed for measuring fixed diameters. It lacked the adjustable feature which was necessary to adapt it to work of different sizes. Of course, the tool could have been heated and altered, but this would have occasioned considerable labor, as well as the loss of the original gauge. It is therefore probable that for an adjustable gauge or caliper, something like that shown in Fig. 2 was employed. This tool consisted of a curved bar of metal with the ends approaching each other, and the adjustments were effected by bending the bar.

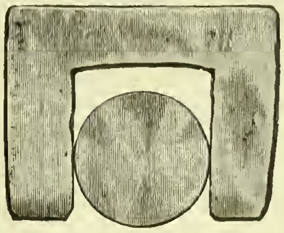


Fig. 1.

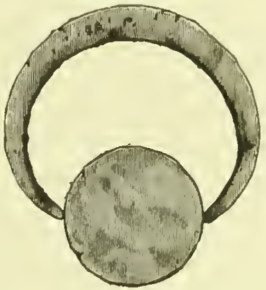


Fig. 2.

An obvious and early improvement upon this caliper is shown in Fig. 3. The difficulty of bending a bar whenever an adjustment was required suggested the use of a frictional joint at the center of the bar, which would permit of swinging the arm of the caliper to adapt it to the measurement of different diameters: From this crude mechanical device have been developed all the modern improved forms of caliper.

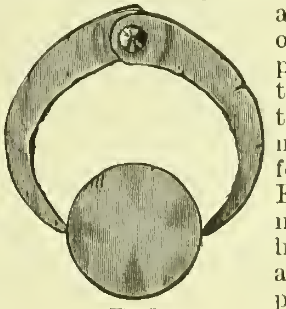


Fig. 3.

The climax of perfection in this line is seen in the Stevens caliper, represented in Fig. 4. In this caliper the jaws are connected together by a fine joint, and a C shaped spring is applied, which tends to separate the free ends of the jaws. The adjustment is instantly effected by a simple and durable slip nut, which, together with the joint and spring, forms an ideal arrangement appreciated by every mechanic.

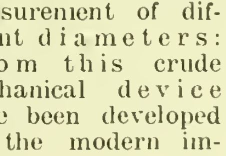


Fig. 4.

◆

AN official inquiry into the causes of the accident to the '*City of Paris*,' has been ordered. These examinations are very searching indeed, but it is not likely that anything new will be discovered.

ELECTRICITY FROM COAL.

IF we may believe what we hear, this much desired end has been attained, and the invention is a practical success. So much so, at least, as to command the attention of such men as Francis A. Pratt, of the Pratt & Whitney Company, of Hartford, Conn. Mr. Pratt is one of the most downright practical men in the country, and well able to judge of the utility of the scheme.

The capital stock is $1,000,000, and none of it is for sale. Francis A. Pratt is the president; R. N. Pratt, of the Pratt & Cady Company, is vice-president; and Ernest Cady, of the same company, is the treasurer. E. Henry Hyde, of Hyde & Joslyn, is a stockholder, one of the directors, and legal adviser of the new company, All the patents asked for by the inventor, Mr. H. B. Cox, have been allowed, and they will be issued in a few days. Both foreign and domestic patents have been applied for.

The apparatus used for converting heat into electricity is so simple that the company does not dignify it by the name of machine. By Mr. Cox's method, heat is changed to electricity as simply as water is changed to steam. His furnace is all that may be seen. From glowing coals comes the subtle current, without the aid of boiler, engine or dynamo.

Before the company was formed, Mr. Cox had a furnace at home by which he ran many electric lights. Experiments and private exhibitions have been conducted on a smaller scale, and in a short time the company intends to show that with the power thus obtained anything that steam or electricity now does may be done. Several members of the company saw what could be done with the furnace of Mr. Cox before any attempt was made to remove it. The one now being built will be an improvement on the old one, and the results from it are expected to be correspondingly better. They will be ready for public exhibitions in a few weeks.

◆

MANY experiments have been made with electricity for lighthouse purposes, but they have not been entirely satisfactory. Several years ago the Government erected a skeleton iron tower at Hell Gate—the tallest lighthouse on the coast. The height was 255 feet. Nine electric lights, each of 6,000 candle power, were placed at the top. As a show the tall tower was magnificent. The ironwork could not be seen, and the lights seemed to be suspended in the heavens. But instead of showing up the intricate and dangerous channels, this grand illumination blinded the pilots. The latter could see nothing beyond a restricted circle. On the petition of those who had originally asked for this lighthouse it was abolished. The tower was sold for old iron, and was thrown down by dynamite. The electric lights on the Statue of Liberty on Bedloe's Island in New York harbor can be seen twenty-five miles out at sea. But they are no part of the lighthouse system.

◆

AN English engineer has patented the beam engine reversed as an adaptation of four cylinder expansion engines, mis-called quadruple expansion. The beam engine—when the beam is on top, or above the cylinders, is especially objected to by English engineers for reasons unknown. When the '*Chicago*,' U. S. N., was constructed, her beam engines were particularly derided, and the editor of an English contemporary—the London *Engineer*, no less—hoped she would not be allowed to go to sea with her beam engines and brick furnaces. The '*Chicago*' has been on sea several months now in continuous service. She is still on top of the water and is doing good work. So our contemporary's apprehensions were unnecessary. The old side lever engine was nothing but a beam engine reversed, and why it is more objectionable with the beam on top, where it is out of the way, is not clear to American engineers.

THE ENGINEER.

FORTNIGHTLY. . . $2.00 PER ANNUM.
Foreign Subscriptions, - . . . . . 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, JUNE 7, 1890. No. 12.

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CURIOUS RESULTS OF EXPERIMENTAL TESTS.

IN the last issue we published an article from the London *Engineer* which referred to some experiments with high expansion engines made by able English engineers recently. These experiments showed such extraordinary results that they are, as one might say, worthless, for they upset all preconceived and accepted theories in regard to the economy of high expansion engines. For one thing, the cylinder condensation was simply preposterous in amount. Professor Kennedy says that in the h.p. cylinder of the '*Tartar*' there was 54.8 of the feed water in the form of condensation; in the intermediate, 50.8; and in the low-pressure, near the end of expansion, 39.3 per cent. condensation. This being simply impossible to receive by the profession, some of them attempt to account for it by the statement that the boilers must have thrown water, primed in other words. To offset this the owners of the boat say that such a thing was impossible from the fact that the boilers were much too large for their work, and were never driven in the least. The coal per square foot of grate surface was only 11.73 lbs. per hour, which may be said to be slow combustion. There are other data obtained upon these experiments which are equally contradicting and unreliable, and it is evident that either one of two things must be done: try the experiments over again with another staff of observers on the same engines, or throw away what we supposed we had learned from observation and experience about high expansion engines and begin all over upon a new basis.

The whole matter is very curious in its several aspects. The observers were men of prominence and ability. There were several of them, and the experiments were continued for many hours. It is of course easy to impugn the reliability of the experiments, but this does not help the case much, from our point of view; it remains to be shown how several men could on this special occasion all go wrong, individually and conjointly, without previous collusion, which is an absurd position to take. We incline to the belief that the experiments will be retried.

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"DON'T READ NO ENGINEERING WORKS!"

AN esteemed correspondent writes that he recently attended a trial of an engine built by a young man who had invented it, and in the course of the trial he inquired if the engine had ever been indicated, and what its efficiency was. To this the answer returned was: no; the young man did not care about indicators, but based his faith that all was well inside the engine by the testimony of his ears; the sound of the exhaust told him all he needed to know. He even went so far as to say that he never consulted technical works or papers, and that he knew about all that anyone needed to know about the steam engine.

Upon a text like this what a sermon could be preached! But is it worth preaching? The persons who need awakening are not present and cannot hear the preacher; even more, they would not listen to him if they were. It is an unquestionable fact that there are a very large class of persons connected with steam, in one way or another, who know but the merest rudiments of their calling, and never wish to know more. So long as the engine runs, after a fashion, and does not make too much noise, the question of economy or efficiency does not concern them. Principles are ignored as being "book learning" which has nothing to do with running an engine. It is time lost remonstrating, or endeavoring to arouse such persons to the fact that they are not engineers in any sense of the word, but mere drivers of engines who utterly fail to grasp the first principles of their calling, which is to "read, mark, and inwardly digest," and to investigate continually. Men who never read what has been done are always inventing useless engines, upon which they spend what little money they may have, or they chase other chimeras in mechanics with the same result. How can they be turned from their folly, asks someone. They cannot. A love for learning and for patient searching into cause and effect is born in men; it cannot be inculcated. Here and there one may be wrought upon to study the principles, but the larger majority are content to grope along in darkness. It is a fact that the veterans and men in high places in the profession are all students. They learn from others' experience, and with their own observation, are able to hold the places they fill with honor and profit.

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NOT A PUBLIC SPECTACLE.

THE danger of handling high explosives in the presence of the public is shown by a recent occurrence. An inventor of a method for firing dynamite from guns with powder charges burst the gun on the first round and scattered the heavy fragments in all directions. For reasons it is hard to understand, the general public had assembled in large numbers to witness the experiment. All that could be seen, even if the trial had proven successful, was the explosion of a dynamite cartridge against a cliff, with the attendant spectacle of a mass of stone tumbling down. On the other hand, there was the possibility of a terrible accident by premature explosion of the cartridge in the gun, or by failure of the experiment. This latter feature duly occurred, and so little account was taken of it, or the probability was deemed so remote, that no shelter in the shape of a bomb-proof was provided, but the spectators were left to look out for themselves. With the fatuity of the average non-professional spectator, they deemed trees suitable for protection against masses of iron propelled by dynamite only a few yards away, and it is only through the fact that none of the fragments struck trees that the spectators did not learn their error. Those who were watching the gun saw it disappear, and the next moment large and small bodies of metal were flying through the air. One piece, weighing 1,000 pounds or more, was hurled to the top of the hill and fell in the midst of a crowd of men, just grazing the arm of one of them. Another, somewhat smaller, scraped the top of a stump behind which three men were lying. One man was struck on the foot by a piece of the shell, and another suffered a slight wound on his cheek. The breech of the gun was broken in two and carried 200 feet to the rear. A portion of the barrel was found about the same distance in front. The gun carriage was reduced to splinters, and the huge timbers that had supported the gun were broken squarely off. Our comments are not upon the failure of the experiment, but upon the danger of permitting a crowd of non-professional persons to witness them without adequate provision. It is a question whether, in the event of mortal injuries to anyone, those who conducted the experiment could not have been held liable for damages.

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SURFACE CONDENSERS.

MANY steam-users in cities and elsewhere are paying large sums yearly for water for steam purposes, which water they proceed to throw away so soon as it has passed through the engine and boiler once. This is a very great waste, which should be and can be easily stopped by the use of surface condensers. These not only save water, but add materially to the power of the engine, by the vacuum obtained. It is a very good every-day engine which produces a horsepower for 30 pounds of water per hour. On that basis only an engine of 100 h.p. would require 3,000 pounds of water per hour or 30,000 pounds per day of 10 hours: this is in round numbers 3,500 gallons without considering waste, the most of which could be saved by the use of a surface condenser. This last requires of course refrigerating, or cooling water circulated through it to condense the steam, but this water can be circulated through the condenser over and over again, being cooled meanwhile by exposing it in tanks on the roof or elsewhere contiguous. In cold storage plants, or in breweries, where artificial refrigeration is employed, it would no doubt be possible to use the cold air rapidly circulated through the condenser tubes instead of water.

This article is not intended to provide plans for the introduction of surface condensers, but only to suggest their employment in stationary plants of large size. They will prove economical auxiliaries where properly used.

TIME IT WAS STOPPED.

It is just a little tiresome to read reports of accidents to steamers with the regulation sentence at the end, saying that the passengers signed a resolution eulogizing the captain's conduct. Inasmuch as the passengers are not capable of judging, in any case, as to whether the captain's conduct was what it should have been, it seems an undignified thing for a captain to ask, or to receive from them, an endorsement of his course. It is wholly ridiculous to do so in many cases. Recently the '*Gascoigne*,' a French steamer, got out of her course in a fog and ran on a rock, knocking a hole in her side. She got out of the trouble all right, and it is gravely added to the report that the passengers signed the usual vote of thanks. In this case the captain did not know where he was by reason of a fog, and only found out when it lifted for a moment and showed him danger ahead. What had the passengers to thank the captain for? Being out of his course, lifting of the fog, or for not going plumb to the bottom? During the recent disaster to the '*City of Paris*,' when the vessel was in the greatest peril from an accident pure and simple, the engineers were in great danger. There is no doubt of this from any aspect,and a testimonial to them from the passengers would have had some pertinence,and have been a graceful thing, but no one has heard of any such testimonial, much less seen one. The chief engineer did not urge some one to go around among the passengers asking them to certify that he knew his business, and did not break the engine on purpose, but it looks very much as if captains did this very thing. They should be above it. They should discountenance it. When an able seaman has to get a certificate from a landsman to the effect that he did his duty, he is a queer sort of a sailor man.

REFORMING ABUSES.

It would seem to be the easiest thing in the world to remedy an abuse or infraction of the laws of the land, but those who undertake to do so, or call attention to abuses, find that they have in too many cases a big job on hand, which calls not only for their time but for their money as well. Even if success is attained and the abuses are checked, the reformer receives no thanks for it from the public, but he does receive a great deal of abuse from persons whose unlawful schemes have been broken up. It is slow work to institute any reform. The machinery of the law is cumbrous. Officers of it are citizens of the community like all others, and they do not care to incur obloquy where by simply ignoring what is plain to be seen they can avoid prosecuting offenders; therefore it is that so many abuses go unchecked, and offenders go scot free.

The excursion season is now open, and, as usual, the boats will be crowded. The law provides penalties for carrying more passengers than a vessel is licensed for, but not one in a dozen infractions are ever punished. They are not even prosecuted, save, possibly, when some unpopular line has incurred the enmity of some official. In cases like these it is important to remember that one-half the fine goes to the informer.

LATEST LEGAL DECISIONS ON TRADE.

REPORTED FOR THE ENGINEER.

[We shall until further notice publish the latest decisions in courts of last resort upon topics of general interest to our readers. From these decisions they will be able to judge in a measure of their own chances in similar cases.]

Custom in Delivery of Goods.—Where it is a custom acquiesced in by the consignee of goods, for a common carrier to deliver goods to an independent warehouseman without notice of such delivery to the owners, who relied upon the warehousemen for notice of their receipt, the carriers cannot be held liable for the safety of goods after delivery to the warehouse, and no liability attaches to it for their subsequent destruction by fire, although the owners had received no actual notice of the delivery of the goods. —*Black v. Ashley, Supreme Court of Michigan*, 44 *N. W. Rep.*

Repairs as Evidence of Negligence.—In an action against an owner of a mill for injuries sustained from machinery alleged to have been defective, evidence that after the accident the defect alleged was repaired is inadmissible for any purpose, either to show that it was negligent for the owner to allow it to be in that condition, or to rebut the testimony of defendant that the repairs were made before the accident.—*Lang v. Sanger, Supreme Court of Wisconsin*, 44 *N. W. Rep.* 1094.

Liability of Master in Employment of Servants.—A master must use due care in the employment of servants, but he cannot be held liable for damages resulting from the mere incompetency of a servant, of which he had no notice.—*Thomas v. Herrall, Supreme Court of Georgia*, 23 *Pac. Rep.* 497.

Patentability of Invention.—A patent for an improvement in lathes for turning irregular forms, which does not specify the materials to be turned, and is substantially the same as a combination previously used for turning articles in wood, although the lathe in question was intended to be used in turning metals, is void for want of novelty, the mere application of the combination to other materials not being patentable.—*Howe Machine Co. v. National Needle Co., Supreme Court of the United States*, 10 *Sup. Ct. Rep.* 570.

Recovery of Freight Overcharge.—Where a shipper delivers goods to a common carrier to be transported over its own and connecting lines, and a contract is made between them for a certain sum for the entire transportation, and the line which delivers the goods at their destination refuses to release them except upon payment of additional freight charges, the remedy of the shipper is against the company which issued the bill of lading, and not against the company which makes the overcharge in the absence of any special agreement with the latter company to the contrary effect.—*Mount Pleasant Manufacturing Company v. Cape Fear & Y. V. Ry. Co. Supreme Court of North Carolina.*

Delivery of Goods to Carrier.—Where goods are delivered by the seller to the carrier addressed to the buyer, without any limitation as to the time or place regarding delivery, the title of the goods passes from the seller to the buyer immediately upon delivery to the carrier, and the carrier cannot, by an agreement in the bill of lading, hold the goods for payment of freight charges due from the seller on other goods involved in prior transactions, though the one to whom such goods have been consigned refused in the first instance to accept the goods, he may thereafter retract such refusal, and after demand for them, maintain an action for refusal to deliver them.—*Bacharach v. Chester Freight Line, Supreme Court of Pennsylvania.*

Contributory Negligence of Injured Servant.—Where a servant is injured by machinery which is not of itself dangerous when used with ordinary care, and where the employer had given him all the necessary instruction, the employer cannot be held liable.—*Zurn v. Tetlow, Supreme Court of Pennsylvania*, 19 *Al. Rep.* 504.

Larceny by Broker.—Where a broker falsely represents to one to whom goods have been shipped that he has a purchaser for them, and on the strength of that representation secures from the owner an order for the goods on the carrier, and thereupon stored the goods in his own name, he is guilty of larceny, and can pass the title in the goods to no one but the person who he represented as the purchaser to the owner. —*Soltau v. Gerdau, Court of Appeals of New York.*

Measure of Damages for Mis-delivery of Goods.—When goods ordered by telegraph are sent to the wrong place, in consequence of an error of the company in repeating the dispatch at an intermediate point, and sending it forward, the measure of damages is the difference in value of the goods at the place that they should have been sent, and their value at the place to which they were actually sent.—*Western Union Telegraph Company v. Reid, Supreme Court of Georgia*, 10 *S. Rep.* 919.

Sale by Sample by Agent.—Where an agent has authority only to exhibit samples and take orders, to be submitted to his principal for his acceptance or rejection, the sale of goods does not take place until the seller accepts the order, and delivers the goods to the carrier for the buyer.—*Claflin v. Meyer, Supreme Court of Louisiana*, 7 *South. Rep.* 139.

Riparian Rights.—Where one has a wharf right along the shore of navigable waters, and upon the conveyance of flats or low lands under high water, the wharf right will be confined to the area contained within the extension of the lateral boundaries, even though these boundaries form an acute angle with the shore line. The proprietor of land on navigable water has an exclusive right to the soil between high and low water mark. That right may be sold and conveyed by miles and bounds. Such property is in fact real estate, and to fill up the space is to commit trespass, and when it has been filled up the party has to all intents and purposes been dispossessed, and an action of ejectment may be maintained.—*Ladies' Seaman's Friends' Society v. Halstead, Supreme Court of Errors of Connecticut*, 19 *At. Rep.* 658.

IT SAVED THE SHIP.

Certainly no new invention ever had a more fortunate introduction to the public than Allison's motorgraph, so-called, which is a contrivance which enables an officer on the bridge to reverse the engines, in fact control them instantly in an emergency. Allison's motorgraph, which is part of the bridge equipment, gives the officer in charge complete and instantaneous control of the ship. Besides indicating the number of revolutions of the screws and the direction in which they are working, the steam steering gear and the engines themselves are placed within the control of the officer in charge. On the first trip of the '*Normannia*' this device came into service. The ship was running 17 knots when a fog suddenly set in and obscured everything. Icebergs had been seen all day, but a little thing like that did not deter the captain from taking all the chances. So he kept on. Suddenly dead ahead, a huge iceberg loomed up, so close that the captain had barely time to reach the apparatus, actuate it, and see the ship swing round almost on her heel; so close, in fact, that the after gangway was smashed against the iceberg in the swing. But for this fact, which it was impossible to conceal, no mention of the danger would have been made. As a matter of fact, Allison's motorgraph saved the '*Normannia*' and her crew, for striking an iceberg while running at 17 knots per hour leaves no one alive to tell how the accident occurred. If the invention is never applied to any other ship, it has done a great work on the '*Normannia*.'

Foreign and Domestic Trade Literature.

ECONOMY OF HIGH EXPANSION, ETC.

It is always claimed for the triple expansion engine that its economy is due to the reduced cylinder condensation, and to nothing else. There is, indeed, a vague, intangible proposition put forward that the higher pressure is conducive to economy. Experiments apparently show, however, that it is to the range of expansion, and not to reduced condensation, that the economy is due. The absolute efficiency, or, to quote from a report, "The ratio of the heat turned into work of the total heat received by the feed-water" was 11.25 per cent. in the '*Fusi Yama*.' In the '*Meteor*' it was 16.1 per cent., but in the '*Tartar*' it was 11.5.

It is impossible to trace anything like a law through these figures. The question naturally arises concerning this 54.8 per cent. of water in the '*Tartar's*' cylinder, how it came subsequently to be reduced to 39.3 per cent. We have repeatedly shown that an engine can only deliver what it receives. If it gets steam and water in the form of priming, it will deliver to the condenser steam and water. The proportions which the two quantities bear to each other can only be affected by two things—the loss of heat due to the performance of work and radiation, and the re-evaporation due to the fall in pressure. But this re-evaporation depends absolutely on the condensation. The metal can do nothing. Whatever steam the engine condenses, because it is metal, it must re-evaporate during the cycle because it is metal; for, if it did not re-evaporate it, the metal would go on growing hotter and hotter until a point was reached when condensation would cease; and, on the other hand, it is impossible that it could re-evaporate more than it condensed, because there would be no water after a little time to re-evaporate. This whole question of cylinder condensation wants thrashing out. It has, so far, set all theories and explanations at defiance. Mr. Willans recently gave particulars of a very curious experience which he had had. The low-pressure cylinder of one of his engines, driving an electric plant, was, as he thought, very carefully drained. It was found, however, that water lay round the corners, so to speak, of the lid. So a small copper pipe was put into the cylinder, just one coil, and high-pressure steam turned into it. The effect was an immediate fattening of the diagrams, and the rise in pressure caused the engine to run the dynamo which it was driving much faster. The gain was very considerable. It may be asked, at what cost? and the answer is easy enough—at no cost; for it sufficed to turn steam into the coil and dry the cylinder, which could be done in less than five minutes, and after that water did not accumulate until the engine was stopped and started again. It is extremely difficult to reconcile this experiment with any known law of the thermo-dynamics of steam. But by far the most curious thing is that so small a quantity of water—there was no room, really, for more than a few spoonsful—should have detracted so largely from the horse-power. The total average pressure was reduced several pounds in the low-pressure cylinder by the water. What became of the energy thus represented? How was it possible for the tiny quantity of hot water to get rid of the steam? The quantity of water did not increase. Mr. Willans stated that the steam seemed to be driven into the water. Putting this in other words, he implied that the water soaked up the steam just as a sponge absorbs water. This was possibly an unconscious revival of the theory held pertinaciously by the late Mr. Wye Williams, and very fully set forth by him in a book which he published in 1860. His theory was that water did not condense steam, but that it absorbed it. Speaking of condensation, he says: "When vapor is thrown into what may be correctly termed an atmosphere of water, each atom is at once compressed or reduced in influence and prevented exercising its full expansive power by the combined densities of the two media—the water and the air. No diminution, however, of the temperature of the vapor atoms follows. They merely remain with their compressed volumes in the water until they escape into the atmosphere, or, by contact with some cold substance, lose their heat, and are then *bona fide* reconverted into the liquid form. Water then, or, indeed, any liquid, cannot be considered as a substance to which heat can be imparted. In a word, heat cannot be received and retained by liquid particles, each of which is susceptible of an instantaneous change in its own statical condition by the accession of heat." The work in question is very curious and interesting, and, although at the time it was written it was regarded as an empty speculation, much has recently come to the surface in various investigations which show that if Mr. Williams had not hit the truth, he had succeeded in elaborating a theory which may indicate the path to it. It is, at all events, very difficult, if not impossible, to explain the phenomena noticed by Mr. Willans on the assumption that the cold water condensed the steam. The peculiar action which takes place when enough water—somewhere about fifty per cent.—is present, and steam is being compressed, bears on this subject, and that strongly.

It is possible that the phenomena of evaporation are still worse understood than the phenomena of cylinder condensation. There is not a formula in existence for determining the rate at which heat is transmitted through a boiler-plate that is worth the paper on which it is printed. If it so happens that the result of an experiment corresponds with a formula, that is pure chance. Thus it has been held that the thickness of a plate has a most powerful influence over the rate at which heat is passed through it, and the Board of Trade authorities will not permit a flue to be used more than $\frac{5}{8}$ in. thick, for fear it should become red hot and collapse; but flues 1 in. thick have been worked in marine boilers in the North with 150 lbs. pressure, and have given no trouble whatever, and are now, after two years' hard work, as good as the first day. It is necessary that the metal be homogeneous, as steel is; laminated iron will blister. But it will blister in a thin flue also. The surface action is the true factor in the transmission of heat, not the thickness of the plate. Again, anyone who would a couple of years ago venture to assert that fuel could be saved by taking steam out of a boiler to heat the feed-water directly would have been regarded as a fool. We have taken some pains to investigate this question. We know that in the P. and O. service Weir's heater is held to save about 4 per cent. in fuel, the steam being drawn from the intermediate receiver. It is, in other words, 4 per cent. more economical to use this steam to heat the feed-water than it is to send it into the low-pressure cylinder. Recently Mr. John Kirkaldy has introduced a feed heater, working with steam drawn direct from the boiler.

To what is this result to be attributed? We have heard it said that it is all due to hot feed-water taking up heat in the boiler better than cold feed-water; that the circulation is better; that air is kept out of the boiler; that air is supplied to the boiler, and so on. But statements of this vague nature have no scientific value whatever. Theoretically, there should be no saving of any kind. There is no thermo-dynamic reason why there should be. But there is a fact; there *is* a saving. We do not for a moment assert that a knowledge of thermo-dynamics has no existence. We do assert that a great deal remains to be learned concerning the thermo dynamics of steam. The day, indeed, is not now far distant when the mathematical investigations of such men as Rankine, Clausius and Cotterill will have to be re-written, in order to bring about some reconciliation between facts and theories.

In conclusion, it is worth while to point out that, throughout his report, Professor Kennedy never alluded to $\frac{T-t}{T}$ as a measure of efficiency. We begin to dare to hope that that venerable impostor of a formula is at last defunct.—*London Engineer.*

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CURIOSITIES OF INVENTION.

Notwithstanding and in spite of all that has been written about that wonderful museum of original ideas, the collection of models in the Patent Office here has scarcely begun to give a notion of the extraordinary freaks of human ingenuity therein displayed. It might be appropriately regarded as a chamber of horrors if one could know what tragedies of disappointed hopes, productive of lunacy and suicide, are represented by these contrivances.

Flying machines and devices for securing perpetual motion are turned out on new plans as plentifully as ever, as is likewise the case with every imaginable sort of product of more or less disordered inventive faculties. So far as the navigation of the air is concerned, it must be owned that the problem has not yet been proved insoluble; but unfortunately the inventors do not seem to advance a particle with it. The patent most recently granted in this line, only a few weeks old, is for an equipment as nearly like a bird's as possible, with folding wings and tail made of enormous feathers of tin and silk. But the gentleman who suggested this apparatus for aerial exercise equips himself at the same time with a balloon big enough to support his weight while he flops along and steers with his tail feathers. And those would-be flyers who do not expect to avail themselves of balloons are in no case able to devise any other method of elevating themselves in the atmosphere than by inclined fans or sails revolving. These ought to raise them, of course, but in practice they don't, somehow. One man, after he has once got up in the air by means of his revolving fans, expects to make his way in any desired direction with propellers at each end of the little boat he sits in. Another thinks to utilize a kite of vast area, within which sails revolve, while a basket is suspended beneath. The kite has a fish tail for steering with. Still another has two cylindrical balloons, between which and beneath hangs a boat; the latter has two large paddle wheels like those of a steamboat, and a propeller in the rear besides. A curiosity in in this way is an air tricycle, with paddles worked by the feet and a balloon to neutralize gravity.

Not less curious than the devices for sailing in the air are those for navigating the water. For instance, there is a model of a boat that is to be propelled by a gigantic windmill, nearly as big as the vessel itself. Of course, in a calm the windmill would not go, but that difficulty is provided against, by a treadmill on deck, which is worked by a horse when catspaws are lacking. Another craft has a steam engine on board that pumps in water through a pipe at the bow and shoots it out at the stern through a sort of water wheel, which in this way is made to revolve and forces the boat ahead by the action of its paddles. This latter notion, by the way, is engaging the attention of capital and inventive talent even now. One man has thought that in the conch shell was to be found the ideal shape for a propeller, and his model is made on the pattern of two such shells put opening to opening. It has never been adopted by navigators, however. Imagine two enormous revolving cylindrical screws, many feet in diameter, extending below the water line on each side of a vessel from one end of a craft to the other, and you have another queer contrivance for propulsion, the threads of the screws being designed to act upon the water and drive the ship onward. One of the funniest of all the devices of this sort is in the shape of an enormous weight hanging like a pendulum from an inclined mast into the hold of the vessel. The waves make the pendulum swing back and forth, and the energy thus produced is utilized by an elaborate mechanical arrangement to run the propeller at the stern. When there are no waves the ship comes to a standstill. But it can afford to do this now and then, inasmuch as the power it uses costs nothing.

There are other contrivances for utilizing the motion of the waves, not less interesting. One is a vessel with its back broken in the middle, so that waves hump it up and down, and thus produce power to work the propeller. It is not explained how the people on board are to keep their feet under these peculiar circumstances; one would think that they would be afflicted with a variety of seasickness unusually intense. A seeming improvement on this is in the form of two separate boats, across which a framework is stretched endwise. Wave motion is supposed to propel this, also, though, as a matter of fact, it doesn't. Perhaps the queerest thing of all is a model of a ship, the entire bow end of which, comprising about one-sixth of the vessel's length, is made to revolve by the mere progress of the craft through the water, and its revolution operates the propeller at the stern. The inventor does not state how the ship is supposed to get started. Small boats to put on the feet for the purpose of walking upon the water, water tricycles, and water bicycles have already become publicly known. A surprising sort of lifeboat is made of two cylindrical shells, one inside of the other, and no matter how often the outer shell may roll over, the passengers in the inner shell, which is hung like a pendulum, must always remain right side up. The great trouble about lifeboats at sea is that they are very apt to turn bottom upward or get swamped in being launched, but this trouble is gotten over by a craft of the sort that has two air-tight cylinders for sides, and is right side up, no matter how it falls into the water, which automatically sets the boat into shape to receive its passengers and crew, the oars being ready fastened in their places for rowing. This wonderful contrivance is rapidly coming into use.

Many glass cases in the model rooms are filled with attempted improvements in sail devices. The most extraordinary of them all is represented by a miniature ship, with one enormous mast extending at an angle of forty-five degrees from the middle deck toward the bow. This mast is equipped with a vast amount of complicated frame work, supporting half-a-dozen great sails in the shape of parasols and umbrellas to be raised in the same way, two big three-cornered sails and a huge square sail. The whole affair looks very much like a Chinese junk.

But these are only a few of the queer and surprising ideas expressed by the 156,000 models in the Patent Office. There is an entire sewing machine made out of a single strip of copper, two-thirds of an inch wide and six inches long. One end of the strip is sharpened into a long fine point, to make the needle, and the affair is worked very much on the same principle as an ordinary sewing machine, with one thumb and forefinger. It will sew, too, but not conveniently enough to make it worth while. The beam of a plough patented many years ago is a gun as well, which was very convenient when Indians were about, because the farmer could so readily turn his horses one side and shoot with his agricultural instrument. Many other curiosities in the shape of guns are there, such as canes and umbrellas that one can shoot with if there is occasion. Also a rifle, the entire skeleton stock of which is a tube filled with hundreds of cartridges. Unluckily, it will not work fast enough to make it serviceable. Then there is a revolver that will fire big bullets or little ones, just as may happen to be requisite.—*St. Louis Globe-Democrat.*

TILLAMOOK LIGHT.

A mile from the Oregon coast a black rock rises nearly 100 feet above the ocean. It is Tillamook Rock. Nature placed it there as the foundation for a lighthouse. Deep water is all around it. Three sides are precipices. The path is very steep. On the highest point after much work a spot was leveled sufficient for a lighthouse fifty feet square. The entire surface out of water is hardly equal to a fair-sized town lot.

When the wind blows and waves beat upon that rock the spray goes over the top and runs down the other side in a torrent. Only when the sea is smooth is it possible for a boat to reach the rock. In October, 1879, four workmen with tools, provisions, fuel, a stove, and some canvas were landed on Tillamook. A few days afterward five men and a small derrick were put upon the rock. The foreman of the party was drowned in trying to make the landing.

These nine men suffered for days the discomfort of shipwrecked sailors. When the rain was not falling the spray was dashing over them. They drilled holes in the rock, fastened ring bolts and tied the canvas to the bolts. In this way they managed to save themselves from being blown or washed away. The next step was to quarry out a little nook in the side which afforded most protection from the wind and waves. In this spot they built a shanty and bolted it to the face of the cliff.

Next they set about quarrying a flight of steps up the steep side, at the same time leveling off the top to get room for the foundations of the lighthouse. Part of the time they worked on staging hung from the top of the rock with the waves dashing below them. There were weeks at a time when almost nothing could be done. In January a tornado came. The waves dashed to the top of the rock, and the wind carried the spray over, so that a continuous flood poured down upon the canvas-covered shanty in which the quarrymen were huddled. This lasted for several days. It swept the supplies into the ocean, and gave the shanty and its inmates a close call. At the end of sixteen days the half-starved men communicated their condition to the main shore. It was impossible for any boat to come to the rock in the sea that was running, but a line was cast loose from the rock and a ship picked it up. This line was fastened to the top of the rock and to the mast of the ship. Over it supplies were transferred to the little colony.

By May the quarrymen had cut down the sharp point of the rock to a height of 88 feet from the sea level and had made a level spot for the lighthouse. Three masons were taken out from the mainland. A small engine and some more derricks were added to the equipment. In June the corner stone was laid. Whenever there was a fair day a load of material was taken out. The rock, quarried near Portland, was hewn into proper blocks before it left the mainland. A square one-story building was constructed for the keeper, with room for the fog signal machinery. From the center of this house the tower was raised 48 feet. This put the light 136 feet above the sea level. It was sixteen months after work began when the light was put in operation. Had the light been burning a month earlier an English ship would probably have been saved. The '*Lupata*' went ashore and twenty lives were lost within a mile of Tillamook. As the ship drifted in she passed so close to the rock that the workmen heard the creaking of the blocks and the commands of her officers, but the night was pitchy dark. The men on the rock lighted a bonfire to warn the ship, but were too late.

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IN 1876 Wagner experimented with common gas and found that the proportion of air to gas, was as five to one to insure ignition by an electric spark. Ordinary illuminating gas requires 6.3 volumes of air to 1 of gas for perfect combustion.

STEEL.

CONCERNING this fickle metal but little is known which is positive. The testimony of various workers in the trades shows that their experience is dissimilar; and despite the years in which it has been used in the arts, steel is capricious and uncertain in its behavior. At one of the meetings of the American Society of Mechanical Engineers some of the members gave their views in certain directions, and a portion of their remarks is given below. A member said:

"An important matter is the re-working of steel for small tools, such as dies, taps, and reamers. These tools are of a great variety, and up to a dozen or twenty years ago, it was a custom almost universal to hand-forge blanks to approximately their final size. These were then finished up and hardened, and I suppose that more various results could scarcely be obtained than were obtained. After a time it began to dawn on some of the master mechanics of these establishments that working steel in a small way was a failure; and I well remember the time when one of them gave out the order that thereafter none of these tools should be forged; that they should be cut from the solid bar. The result was an immediate and very great improvement, and I believe they have never gone back to the old method. The former practice had been so various that very naturally all sorts of theories were afloat as to just how steel should be heated, and just how it should be cooled. The theories were, indeed, almost as various as the steel workers themselves. At the present time I believe the general practice has become substantially uniform. One tool-maker of the olden time would argue that steel would swell by being hardened. Another would argue that it would shrink, and so on. Men working side by side would maintain opposite theories. Much more in this line might be said, but the only point I wish to make is this: that steel suitable to be used for small tools is not improved by working after it is first made. Its true and proper character is given to it in the making, and follows it through life. It is reported by several competent tool-makers that the preferable method of making steel tools requiring accurate form is first to shape the piece approximately, then thoroughly to harden the same, next and immediately to anneal it carefully and slowly, and finally to reshape the piece and harden and temper in the ordinary way. The first hardening is claimed to induce those internal strains and warping due to the cooling of a piece of the particular shape, which strains are at once relieved by the immediate re-annealing of the piece. The re-shaping, by reducing the entire surface of the article, removes the numerous incipient fire cracks which are inevitably formed, thereby greatly lessening the danger of cracking at the final hardening.

"My experience with bushings that we introduce in our engines, and hardened steel stems, is that we do not heat them to a point where they would scale, but take considerable care in the heating of them. Being slow about it, and keeping the temperature down below the scaling point, we do not find any enlargement. Our fits are made reasonably close to run, and usually the stem can be pushed into the hole—they are some 9 in. or 10 in. long—and then it is relieved by straightening up in the process of grinding—of course the larger and the longer the more care. In the steamer '*Nashua*' we have stems some 9 ft. long and 2½ in. in diameter. He came back and said that no more steel should come into any work of his. After one or two trials I took the matter in hand and rigged up a barrel of ice water, leaving part of the head in the barrel—I will explain that the steel was about 2 ft. from the end where it had been hardened, with a space about 18 in. long at each end. I rigged up a guide to drop vertically, and heated the steel slowly and dropped it quickly into the water. It came out practically straight, copying the operation as used in straightening files while the steel was warm. Putting it on the centers, a shaft some 9 ft. long was practically straight and without any scale; ran very nicely; and it occurs to me that the proper way to harden steel and keep it straight, especially bars that you wish to maintain in a parallel position, is to get the hot surface under solid water as quickly and as vertically as possible, so that the surface of the water will not influence the part that is to be hardened unevenly by ebullition. I do not think the closing around of the chilling operation of the water can be too quick. The only improvement I suggest would be, if we could erect a cannon and shoot the steel like a ramrod into the water, we would have a straight piece after cooling."

The Chairman: Did Mr. Wheelock move the steel in water as in tempering, or let it be still? When you put this rod of steel down in the water, did you let it remain still in that way or keep stirring it around?

Jerome Wheelock said: No, sir, we let it be its own way, falling vertically into the water. The bottom of the barrel was supported by a flat rock, and we left it there until it was warm—what a person would call warm, being able to bear the hand on the surface—and then straightened it a little. The worst case of springing in the bearings that we had to deal with was less than one thirty-second of an inch out of true. That was straightened by the operation. The place of hardening was true, but at the point of leaving the hard it was a little changed, due, I presume, to ebullition.

Mr. Geo. E. Whitehead said: In my experience we get more trouble in hardening in the winter than we do in summer, and I am inclined to think that dipping in water too cool has the effect of breaking tools a great deal quicker than if the water was of a milder temperature. I have hardened a great many dies, and had quite a number crack. Most of the dies that cracked came from the softer or inferior grades of steel. Where we use the higher quality of tool steel we do not lose so many dies in tempering. I have had a good deal of experience such as has been mentioned by the different members. I have put soft steel shafts in presses where they would run six months and break, and replaced with wrought-iron, they have run three or four years before breaking. I have also taken threading dies that were too large and made them smaller by re-hardening, and I presume a great many mechanics have had similar experience.

THE OLD, OLD STORY.

THE frequency of boiler explosions, and the general apathy of the public in regard to them, leads us to publish the testimony appended, for it shows very conclusively the cause of very many of these occurrences. This explosion took place in England:

"A formal investigation by the Board of Trade was held respecting the boiler explosion which occurred at Crosby, near Liverpool.

The boiler was of the Cornish type, 9 ft. 9 in. in length, 4 ft. 10 in. in diameter in the shell, and 2 ft. 4 in. in the furnace tube, the plates throughout having been originally $\frac{3}{8}$ in. thick. The working pressure was between 40 lb. and 50 lb. on the square inch Failure occurred at the back end of the shell, where resting on the brickwork seating, at which part the plates were considerably reduced by external corrosion. The boiler was thrown from its seat and four persons injured, including a boy, the son of one of the owners.

Mr. Gough stated that the boiler, with an engine of 8 h.p., was purchased second-hand for 20*l*. from a broker in Liverpool some ten or twelve years ago. No information could now be obtained as to the date of make nor as to the broker's name.

One of the owners deposed that he and his brother had carried on business as ropemakers for the last eighteen months. The boiler was bought second-hand ten or twelve years since, and after purchase it lay on the ground six or seven years uncovered and exposed to the weather. It was fixed and set to work about four years ago. No one examined it at the time it was bought, nor since. The idea of examination had never occurred to them. The usual working pressure was 30 lbs. to 40 lbs., but it had been as high as 60 lbs. The safety valve blew off at 45 lbs. to 50 lbs., but when they required extra pressure, which was only occasionally, an additional weight was put on the end of the lever. The last time this was done was a week before the explosion. The boiler was worked on an average only three days a week, and it laid idle for six months. At Christmas last one of the plates at the bottom of the shell near the blow-out tap leaked, and a patch was put on by a boilermaker. The plate was worn through, but he had not the least idea that any other plates were thin. He did not tell the boilermaker who made the repairs to examine the boiler. He had stopped the engine to attend to the packing of the pump. The safety valve was blowing off and the guage registered 45 lbs. He was about to start the engine when the boiler burst. He could not say whether the seating was kept dry.

He believed the cause of the explosion was thinning of the plates by external corrosion. At Christmas he saw that the plate at the front, which was subsequently repaired, was thin, but did not examine the plates elsewhere, as he had no idea there was anything wrong. There was always a leakage at the front, and, therefore, he had the patch applied. The boiler was not insured. Neither he nor his brother understood much about boilers, and he regretted that it did not strike him that the other plates might be thin.

Mr. Thomas Usher, the other partner in the firm, said he did not know how old the boiler was. His father, who had no mechanical knowledge, but who always tried to get a good bargain, bought it. For some time it lay exposed to the weather, and when it rained the ground would be damp, but it never occurred to him that this would cause corrosion. No examination had ever been made of the boiler so far as he knew. At Christmas he saw water coming through the corroded plate at the front, but did not suspect that the plates towards the back would be thin. He could not say how long he expected the boiler would work. It was not insured, for he was under the impression that the Government inspector came round to examine.

Mr. Commissioner Smith: Did you ever see a Government inspector examining a boiler? Government inspectors have no power whatever to examine land boilers. Did you consider the boiler safe as long as it was not leaking, or was the leakage a test of safety?

Witness, in reply, said he was a ropemaker, and not an engineer, and did not understand boilers. So long as he could get steam up and the boiler did not leak he thought it safe.

Mr. Gough here reminded Mr. Usher that he was the owner of the boiler, and therefore responsible. Why did he not have the boiler insured?

Witness replied that his father did not have it insured, and he personally never thought about it. He and his brother were only beginners, and had no means. They had borrowed money to pay the other members of the family for the works. It would certainly have been better to have had the boiler examined. He was not present when the explosion occurred. He had seen the guage previously at 25 lbs. His own boy was seriously hurt and was still in the hospital.

Mr. Hutton Winstanley, boilermaker, Bootle, deposed to having been among boilers and engines for thirty or forty years. He often examined boilers, and charged 10s. or 11s. for examination. He did not examine the exploded boiler, not having been instructed to do so, but he repaired it by a patch last Christmas at the front end, near the blow-out tap, where the plate was only $\frac{1}{16}$ in. thick. He did not sound the plates in any other part, as he was not employed to inspect the boiler, nor did it occur to him that there was any more corrosion than that at the front. He told Messrs. Usher that the plate near the blow-out tap was thin, but did not suggest that any other part would be wasted. The corrosion at the part he repaired would probably be caused by damp ashes, and the other portions of the boiler would not, therefore, be suspected of being damp. He had known boilers last seventeen years without being corroded. He did not think the boiler was safe to work at 60 lbs., but if he had tested it to 60 lbs., and it proved right, he would not have hesitated to work it at 50 lbs.

Two workmen in the employ of Messrs. Usher gave evidence to the effect that shortly before the explosion steam was blowing off at the safety valve, and that there was no extra weight on the lever at the time.

Mr. Seaton, Board of Trade engineer-surveyor, Liverpool, who made the prelimary investigation, produced a photograph and sketch of the boiler and two pieces of the corroded plate. The whole of the last plate at the back end, with about half of the adjoining plate attached to it, was torn off bodily in one piece and shot some distance. There was evidence of external corrosion along the right hand side of the boiler where, resting on the brickwork seating, but the worst part was at the primary rent, where the plate was as thin as brown paper. The boiler was not safe to work at any pressure. Had he seen the corroded plate at the front where repaired last Christmas, it would have strongly suggested that the remaining plates would also be corroded, though he was almost sure Mr. Winstanley could not have seen the plates, part of which he produced, because they would be covered by the brickwork. The corrosion was mainly external.

In reply to Mr. Lang, witness said it was surprising the boiler stood any pressure at all.

Mr. Smith inquired of Messrs. Usher what they had to say with regard to the question of blame attaching to them for the explosion.

Mr. Levi Usher replied that the explosion was an accident, and had been a sad blow to his brother and himself.

The Commissioner: It should not be called an accident. The term "accident" in connection with boiler explosions could not be admitted. The explosion was due to a preventable cause.

Mr. Thomas Usher said he was quite ignorant with respect to boilers. That was his defence. He was fined $150.

On Saturday, April 12th, a formal investigation was held at Halifax, with regard to a boiler explosion which occurred on March 8th, at a small mechanic's shop, in Halifax, owned by Messrs. Crowther and Sharp.

The boiler was a very small one, of the flat-ended, externally fired class. It measured 3 ft. 9 in. in length, by 1 ft. 10 in. in diameter. The plates originally were $\frac{3}{8}$ in. in the shell, $\frac{1}{2}$ in. in the front end, and barely $\frac{3}{8}$ in. in the back. It was only worked about once a week by two young mechanics who used it, for the purpose of turning a couple of lathes. The pressure was stated to have been 65 lbs., but proved on calculation to be as much as 85 lbs. The back end-plate was blown out and the boiler shot forward, killing a young man, as well as scalding some children playing near. The cause of the explosion was external corrosion, the back end-plate at the point of rupture being wasted almost completely away.

Richard H. J. Crowther, a youth about eighteen years of age, one of the owners, deposed that he was an engineer's apprentice, but had had no experience with boilers. Along with another young man named Sharp, he purchased the boiler, with a small engine, in June last, for 30s. No examination was made of it at the time, but the man they bought it from told them that it had been tested with a hammer, and that it had worked at 60 lbs., and would do so again with safety, so they they thought it good. He made no calculations as to its strength; he could not. The boiler was built in bricks and kept in an outhouse, being used in spare time, say about once a week, for amateur work and for driving two lathes. The weight on the safety valve was set to blow, according to his calculation, at 65 lbs., and by the gauge it did so. He did not think this pressure excessive, as the plates appeared thick enough. The explosion occurred on March 8th, and a young man who voluntarily fired up for him, was killed. His father and several children were injured, and damage amounting to about 40*l.* was done to property. They had never had the boiler examined or tested in any way. It did not occur to him that 30s. was a very small price to pay for the boiler.

By Mr. Howard Smith: He was being educated as an engineer and had served four years. He had had no instruction as to working boilers.

By Mr. Lang: The pressure at the time of the explosion was 78 lbs., but they were not in the habit of working at that. He thought the safety valve was defective, and the fire door being open and the engine stopped, that this caused the pressure to rise. He could not get to the end of the boiler to sound it as it was set in bricks.

Mr. Lang: You were very much to blame for carrying more than 60 lbs.

By Mr. Gough: He made calculations as to the length of the lever and as to the pressure, but did not know how he made them. They came out at 65 lbs. He did not think he made a mistake of 20 lbs., and that the result of this calculation should have been 85 lbs.

By Mr. Smith: He had read a book about boilers, and was taking lessons in steam and applied mechanics, but had not studied boilers. He had heard the valve blow at 65 lbs. by the guage.

Ernest Sharp, joint owner of the boiler with the previous witness, said he was twenty-one years old, and just out of his time as engineer's apprentice. He had had no experience with boilers, and never examined the exploded one. He had cleaned it once or twice, but never noticed any corrosive pitting. He had seen the valve blow at 65 lbs., and had not known the gauge to rise above that point. At three or four o'clock on the afternoon of the explosion he saw the gauge, and it then registered 60 lbs.

By Mr. Smith: He thought the boiler, though an old one, would be safe at 60 lbs., as the shell plates had been $\frac{1}{2}$ in. thick.

By Mr. Lang: He did not think they were running any great risk in working at 65 lbs. He thought all was safe.

By Mr. Gough: He did not know of any similar boilers used for similar purposes in the district, or whether they were insured or examined.

John William Stead said he was a roller coverer, and sold the boiler to Crowther and Sharp. He purchased it with a small vertical engine and some steam pipes from a man named Burroughes, but did not remember when. He paid 2*l.* 5s. for the lot. He did not pay in money, but gave a silver watch, which was valued at 2*l.*, and 5s, for it, making 2*l.* 5s. in all. He only used it about three times, and at 60 lbs. pressure. He kept the boiler twelve months, and then sold it at a loss, as the engine was not strong enough to drive his lathe. When he bought the boiler Burroughes tested it by striking it with a hammer. He struck the shell and end plates all over, and looked as if he struck hard. As Burroughes told him he had worked at 60 lbs., and that it was safe, he thought himself justified in working at that point.

Jesse Burroughes, a machine and tool maker, said he had fired one or two boilers, but had had no practical experience with them. He purchased the exploded boiler three years ago at Northouram, near Halifax, but from whom he did not know. He was having a walk one Sunday morning and saw it in a yard. He paid 23s. for it. There was a safety valve and a lever, and also a water gauge and a pressure gauge, but no engine. He bought the boiler because he had a fancy for it, as he wanted it to drive a lathe which he had made. The man he bought it from looked like a farmer; he had tried to find him, but could not, and had heard he was dead. The man told him it was made of $\frac{1}{2}$ in. plates. He did not inquire what pressure it had carried. He bought it first and examined it afterwards.

Mr. Gough: If it had been a tin boiler would you have bought it? Do you often buy things like that without examination?

Witness: He thought the boiler all right. The reason he stopped working it was that it burnt too much coal. He told Stead that he had had it at 60 lbs., but did not tell him it was good for that pressure. He hammered it with an 8 lb. or a 10 lb. hammer, especially at the part which burst, hitting it extra hard at that part.

By Mr. Lang: He thought if he took the hammer in both hands and struck hard, and the plates seemed sound, that the boiler should stand the pressure.

Joseph Crowther, grocer, father of one of the owners of the boiler, said he had consulted some friends of his, who were boilermakers, as to the pressure, and they said the boiler was safe enough at 60 lbs.; indeed, one said he would sit on it at 80 lbs. He told his son and Sharp to keep it at 60 lbs., and warned them to be careful. Just before the explosion he saw that the pressure was 78 lbs., and shouted out: "Boys, your steam is very high; get your engine going." In reply he heard a chorus of voices saying that they were just going to start. He did not hear the valve blowing, but so far as he knew it was free, and there was no extra weight on the lever. He was frightened when he saw the guage at 78 lbs. Two minutes after he called out the explosion occurred, and he was struck by the boiler.

Mr. W. H. Woodthorpe, Board of Trade engineer-surveyor, said he had examined the boiler after the explosion, and found that the back end plate had been torn away from the shell. He produced the plate for the inspection of the Commissioners. It was practically worn down to nothing by external corrosion. The bottom of the shell also was as thin as the end plate. He thought the boiler was originally intended for a greenhouse and for a very low pressure. Without corrosion and when new, it might have been safe at 30 lbs., but at the time of the explosion it was not safe at any pressure. The load on the safety valve by calculation was 85 lbs. He saw the pressure guage, but it was too much damaged to be checked. The bursting pressure originally would be 150 lbs., and it was working at three times the pressure it would have been safe at when new.

In any part of the world anyone can put up a second-hand boiler and run it for all and more than it is worth, but it needs a special license to keep a pound of gunpowder on the premises.

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THE unreliability of the reports concerning new steamers, and the stuff published by daily papers concerning them, is exasperating. Here is the '*Normannia*,' which has recently made her first trip credited with screws 18′ diameter by 32′ pitch. She is said to have averaged 83 revolutions on her first voyage. This gives by a simple calculation a speed of 30 miles an hour, minus 960 feet, for the screw; with 10 per cent. slip, the ship made 27 miles an hour all the way over. On the trial trip she made 21 knots with 93 revolutions per minute. So either one of two things is plain; the screw is not 32 feet pitch or the engines did not make the revolutions they are said to have.

THERE are five means by which the supplementary feed supply of marine boilers may be secured. First, by the old method of taking water to make up waste direct from the sea. The result of this with high-pressure boilers has been unsatisfactory, deteriorating the boilers, lessening their efficiency, and causing serious accidents of thick scale on the heating surfaces. One thousand gallons of sea water evaporated in a boiler per hour would give upwards of 100 lbs. of deposit in twenty-four hours.

Secondly, by fresh water carried in tanks, which can only be done with advantage on short runs, and where the question of carrying 100 tons less cargo is of no moment.

Thirdly, treating sea water chemically, to purify and render it fit for use. To do this it becomes necessary to use some compound for the purpose of precipitating the salts, which form an element in sea water. The vessel in which this process was carried out would be to cause great inconvenience, and the ordinary rolling at sea would prevent the operation being conducted in a satisfactory manner.

Fourthly, by using an auxiliary boiler to evaporate sufficient salt water for feed make-up. This is a crude and extravagant method. The heating surfaces soon get coated with scale, when the evaporative efficiency per pound of coal is reduced to a minimum. The system has nevertheless found users, but in several cases the fire boxes have been destroyed, having probably saved the main boilers at the expense of the auxiliary boiler.

Fifthly, the make-up feed may be produced by evaporation of sea water by steam, which, though giving up its heat to evaporate the salt water, is not allowed to come into contact with it. This is without doubt the most economical and efficient means of securing fresh water, as it avoids salting up boilers, etc. Several apparatus are now made, and are largely used for this purpose.—*London Engineer.*

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TIMOTHY HACKWORTH, one of the earliest English locomotive makers, once built an engine like this: The peculiarities of its construction were that it had cylinders of 17 in diameter by 9 in. stroke, and 5 ft. driving wheels. It was a six-wheeled engine with single drivers. It was supplied with a cross shaft, on which were hung two solid cast-iron wheels. On each end of this shaft a lever was attached, by which the driver and firemen could pull down the solid or friction wheels between the periphery of the driving and trailing wheels, thus temporarily connecting by friction the large drivers and the small trailing wheels; in other words, converting a single engine into a coupled one, when needed by greasy rails. The engine, as will be clearly understood, was a bad starter, and never did any good service. An engineer who saw it states as follows: Many years after it was built I happened to be in the North, and inquiring about my old friends I was informed that the *Arrow* was still at work, but that the short crank had been taken out, and a 9 in. put in, still keeping the same cylinders. It was effected by putting in a lever, the top end of which was fixed on the boiler bottom; the piston-rod took hold of the middle of its length, and from the bottom end the connecting-rod was worked. I need hardly say that such a scheme did not emanate from the brain of Timothy Hackworth, but was, as I heard, the idea of a draper in Darlington.

Well, pretty soon some one will revive it, here and get up a company to build it.

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WE read of an inventor—who designed machinery at great cost to the stockholders, who had formed a company for the purpose of introducing the goods—abandoning his system and proceeding on an entirely new basis, rendering the old machines useless. That is pleasant for the stockholders!

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DURING the year 1889 5,000 miles of railway was constructed in the United States, 753 miles in Canada, and 369 miles in Mexico.

TRADE NOTES.

RUBBER manufacturers have advanced prices 10 per cent., to take effect June 2.

* * *

A HOTEL to cost $2,000,000 is to be erected at Thirty-fifth Street and Fifth Avenue, New York, in the fall.

* * *

THE effect of the electric light current on the compasses of some vessels is so great that it becomes necessary to determine how many hours the dynamo has been running before working out the vessel's reckoning.

* * *

A CERTAIN West End manufacturer recently had several notices posted warning employees not to meddle with the machinery, etc., if out of order. When pay day came around he deducted from each employee's wages ten minutes' pay for time lost in reading the notices.—*Cincinnati Enquirer.*

* * *

THE most expensive thermometer in this country is in use at the Johns Hopkins University. It is known as Prof. Bowland's thermometer, and is valued at $10,000. It is an absolutely perfect instrument, and the graduations on the glass are so fine that it is necessary to use a microscope to read them.

* * *

AN Australian musician has invented a trombone that is played by steam. Its "God Save the Queen" can be heard at a distance of four miles. He had hard luck with it, however, for the people of his own town drove him out as a nuisance; and now he is bound to make a noise in some other part of the world.

* * *

ONE down-town jeweler received an order lately unlike anything he ever received before. This was a set of hot air registers to set in the floor. They were made of brass from designs by the architect, and his orders were to plate them heavily in pure gold. When finished they are to submit to being walked upon in the country house of Mr. Rockefeller.

[Maybe this is true, but we don't believe it.]

* * *

A NEW IRON steamer left Newcastle, England, last month on her first voyage. In the course of it she got into a heavy fog. The electric search light showed something white a little distance ahead like a cloud, and immediately a great iceberg loomed up. The helm was put hard to starboard, and the ship just cleared the ice, crashing, however, into a huge ledge which jutted out from the berg. There was a heavy avalanche of ice, which threw the ship on her beam ends, but she soon righted, and, though leaking, got safely into New York harbor. But for the electric light nothing could have saved the vessel and crew.

* * *

IN a recent lecture on "Flameless Combustion," Mr. T. Fletcher said: "The appearance of flame is misleading, and the greater the flame the smaller the work done, other things being equal. I have been asked by a well-known engineer if I could explain why certain boilers gave such an exceedingly small duty for the fuel consumed, when the flues were, as he said, 'filled from end to end with magnificent flame.' The fact was that his so-called magnificent flame was a delusion, hollow and cold inside, and not coming into contact with his boiler at all, When the same fuel was burnt with a very small flame, hardly visible over the bridge, the duty increased some 30 per cent."

* * *

THE '*Castalia*' and the '*Manola*' had a brush the whole length of Lake Huron recently. The '*Castalia*' had a small lead on leaving Port Huron, with the '*Manola*' close after her. So even and regular did the pace continue for fourteen hours that a piece of twine stretched between the two boats at Port Huron would have remained unbroken up till the time they parted. The clockwork regularity of the machinery is to be credited with the above record.—*Marine Record.*

The "suction," so-called, had much more to do with it. A fast boat cannot get away from a slow one if the latter can once get near enough to catch her "suction."

* * *

THE annual report of the Thomson-Houston Electric Company shows the enormous business done by such concerns. The account, February 1, 1889, was $1,411,240.73, from which there has been divided among the shareholders $1,000,000 as stock dividend, and a cash dividend of $35,000 on preferred stock. There has been added $1,309,175.19, making the present surplus $1,685,415.92. The amount of annual business has increased from $300,000 in 1883 to $8,000,000 in 1889. The company have about 100 lines of electric railways under contract and in operation, aggregating over 1,000 cars, as a result of less than two years' operations of this department.

* * *

THE United States Mint recently contracted for a balance for weighing gold and silver coin, which is of remarkable size and capacity. It has just been completed and placed in position at the mint, where it gives satisfaction. The beam is 72 inches long. It will carry 10,000 ounces in each pan, and indicates the 100th of an ounce. During the year's time millions of dollars' worth of gold and silver is weighed upon this balance, hence its value cannot be underestimated in drawing a hair line between the buyer and the seller. It is probably the largest balance of its kind in the world. Thus says an exchange, but it would seem that the possible error of the 100th of an ounce would, in a period of years, make Uncle Sam very rich, if the error was in his favor always.

* * *

THE National House Committee on Patents has directed a favorable report on a bill amending the patent laws in several material points. This bill provides, among other things, that publication for a period of more than two years previous to application shall debar an applicant for patent; limits the time for final action upon a claim to one year from the time of the filing of an application; gives the court, in patent cases, the right to pass title to a patent by decree, without any act on the part of the defendants: grants an alien the right to file caveats through agents, in cases where his native country affords like privileges to citizens of the United States; and, finally, provides for the imposition of a tax of $10 on every patent after the first five years, and $25 after the first ten years, under penalty of vacation of the patent.

* * *

AN arrangement for the prevention of accidents by the electric current has been adopted at the works of the Morgan Engineering Company, of Alliance, Ohio. A board is fixed on the wall facing the dynamo in the engine room. On this board are six hooks on the checks of the six men who are employed in looking after the circuits. When a man is called on duty, he removes his check from the hook and takes it with him. The engineer sees by a glance at the board that one hook is absent, and that, therefore, one man is engaged about the lines around the shop, and the dynamo is not started until the check is replaced on the hook. The engineer then understands that the coast is clear, and turns on his current without fear of accident to any of the linemen.

* * *

PROMOTION has been very slow from the grade of Assistant Engineer to that of Passed Assistant Engineer in the navy for some years, owing to the provision of the law that there shall be only one promotion for every two vacancies until the number of Passed Assistants has been reduced to sixty. There has been complaints among the Assistants tnat they were still further kept back by the fact that a number of officers are carried on the active list who are physically incapacitated for service and ought to be retired. In order to afford all the relief possible the Secretary of the Navy ordered Passed Assistant Engineers William A. H. Allen, C. J. Habighurst, R. D. Taylor, and W. R. King, and Assistant Engineer C. C. Willis to appear before the Retiring Board for examination for retirement. If these officers are all retired two Assistant Engineers will be promoted.

* * *

MR. F. HOWARD BOYER, at the Department of Physics, Brooklyn Institute, spoke upon the system of producing ice for domestic and commercial purposes. He described the various methods of the use of anhydrous ammonia, and gave some figures on the subject. A plant capable of producing twenty-five tons of ice in twenty-four hours, consisting of buildings, boilers, and apparatus, would cost $20,000; two engineers, $6 per day; two firemen, $4 per day; four tankmen, $8 per day; two and one-half tons of coal, $10.50; gas and oil, $1 per day; interest, $3, making a total of $32.50. This would amount to $1.30 per ton. The delivery of the ice would, perhaps, amount to $2 more, making a liberal estimated cost of $3.30 per ton for the total cost. The larger the plant, according the cheaper the per ton. Mr. Boyer's estimates were for the can system of making ice, which turns out cakes of 250 pounds each, made from distilled water.

* * *

CORRUGATED steel furnaces for boilers are manufactured solely in the United States by the Continental Iron Works, Brooklyn, N. Y., who find the demand for them steadily increasing. Some of the recent orders filled by them are as follows: 8 furnaces to McNeil & McLachlan, Brooklyn, N. Y., for the new steel fire boat '*New Yorker*'; 2 furnaces for the Vertical Tube Boiler Co.; 16 furnaces to the Quintard Iron Works, N. Y., for U. S. Cruiser No. 11; 8 furnaces to the Union Iron Works, San Francisco, Cal., for Ss. '*City of Panama*'; 16 furnaces to the Morgan Iron Works, N. Y., for steamer '*Rhode Island*'; 2 furnaces for the Lake Erie Boiler Works, Buffalo, N. Y.; 3 furnaces for the Atlantic Iron Works, East Boston, Mass.; and 5 furnaces just finished for M. T. Davidson, Brooklyn, N. Y., for boilers for Brooklyn Water Works. The Continental Iron Works have also just completed and delivered to the Brooklyn Navy Yard, 56 of their corrugated furnaces for U. S. cruisers Nos. 7 and 8.

* * *

THE Fall River Iron Works mill is driven by two tandem triple-expansion engines attached to opposite ends of the same shaft. It is rated at 1,300 h. p. running at 65 revolutions per minute, and with 150 lbs. initial pressure. The high-pressure cylinders are 16½ in. in diameter, the intermediate 28 in., and the low-pressure 42 in., the stroke being 5 ft. The flywheel is 28 ft. in diameter, 114 in. on the face and carries four belts, two of which are 32 in. in width, one 26 in. and one 16 in. The pulley weighed, when finished, 97,728 lbs. The cylinders are steam jacketed and cased in sheet metal instead of the usual black walnut lagging. The wrist plate is superseded by the more modern arrangement now used by the Corliss Company, securing a more rapid movement to the valve. Each cylinder is provided with the Corliss Company's new release valve, allowing for the escape of entrained water. This consists of a long flat steel spring, the ends of which press upon valves located in the back bonnets of the exhaust ports. An excessive pressure, such as would be generated by the confinement of water in the cylinder, lifts these valves against the action of the springs and allows the water to escape. The engines have been in continuous operation since October 15, 1889, and develop 1,400 h. p.

* * *

PROF. ELIHU THOMSON, in speaking on "The Problems of the Future," says: "In the near future railways will be run by electricity; not the small roads, I mean, but really the large ones connecting cities, and there is no reason why we should not expect higher speeds than we can attain at present with our steam locomotives. There we have reciprocating parts that must be put in motion, stopped and reversed continually, while in the electric locomotive we have the simple rotary motion, which is all we need, which makes it possible accordingly to run at a much higher rate of speed. Although the steam locomotive has been very much improved, yet it can hardly compare with the economy of stationary engines, placed where they can have an abundant water supply for condensing purposes. We can, therefore, by employing stationary engines and electric roads, do away with a great deal of unnecessary weight, and the moving parts being symmetrical, we can attain a much higher speed, say a hundred miles an hour. This would be a grand step forward, which would save us a great deal of time. It might even be possible to reach a speed of 150 miles an hour; it simply depends upon finding the method of applying sufficient power, and building the locomotives to suit, arrangements being adopted to keep the cars on the track.

◆

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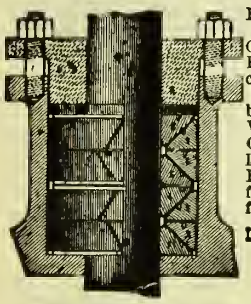

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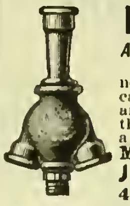

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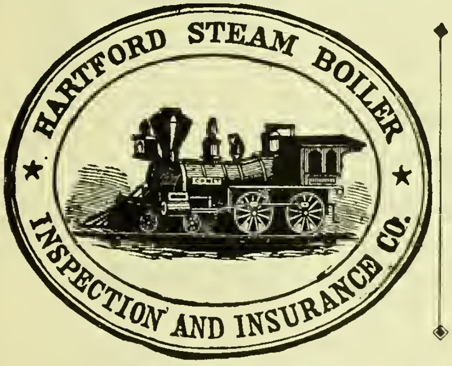

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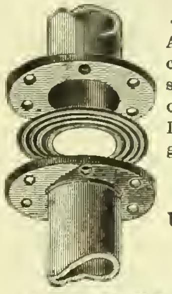

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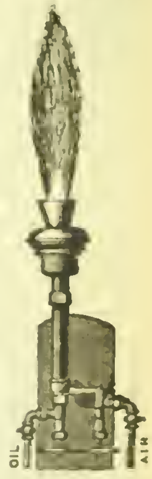

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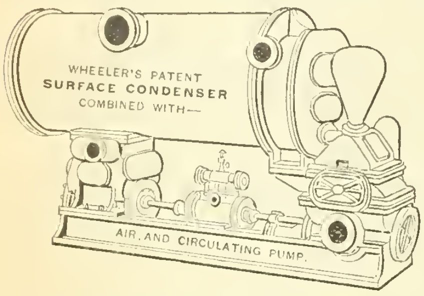
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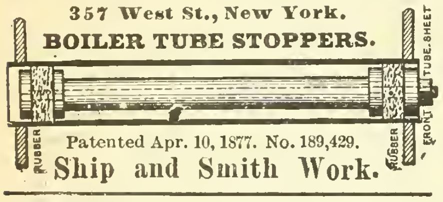

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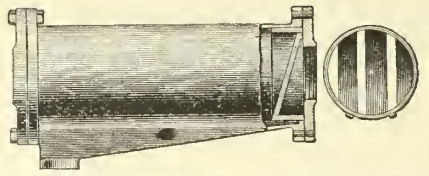

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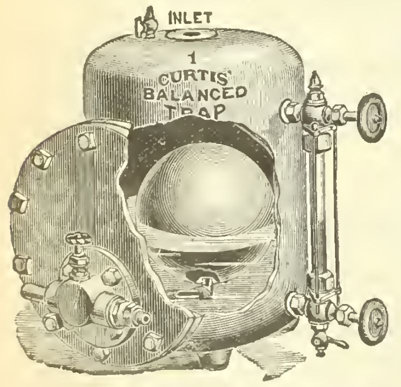

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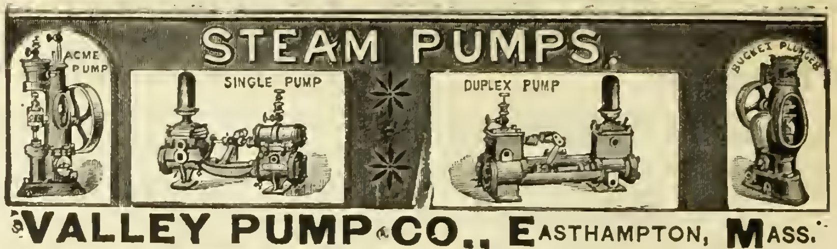

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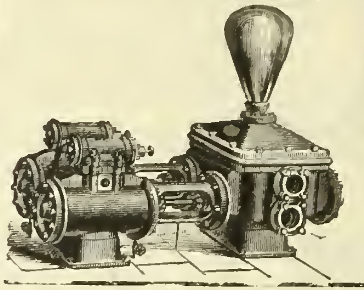

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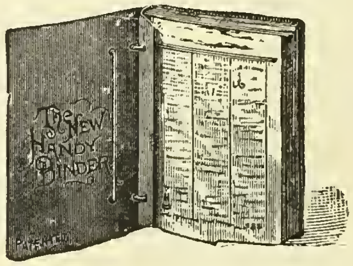

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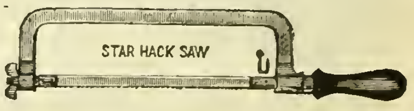

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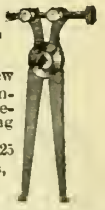

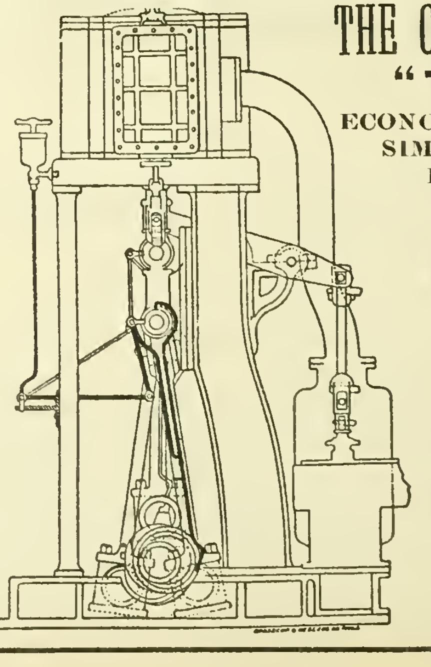

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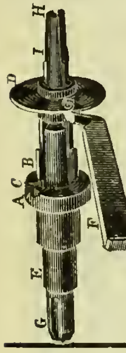

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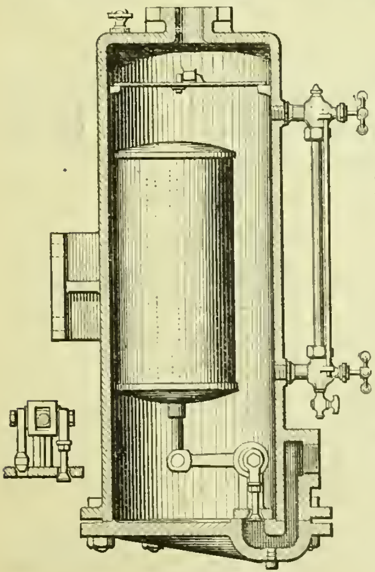

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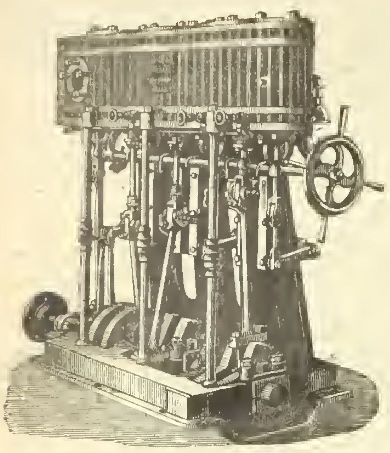

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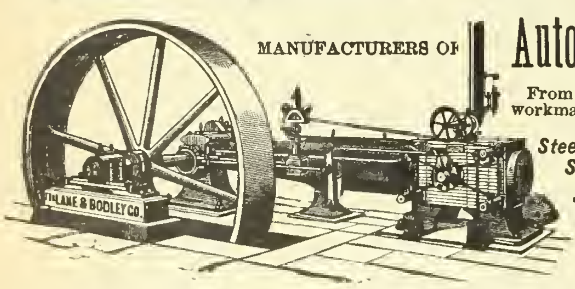

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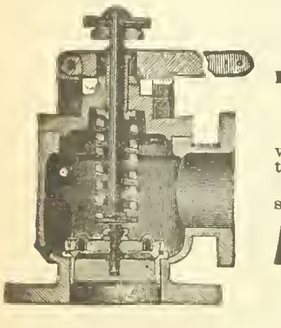

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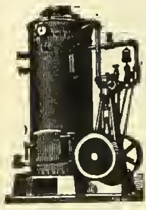

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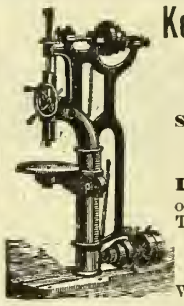

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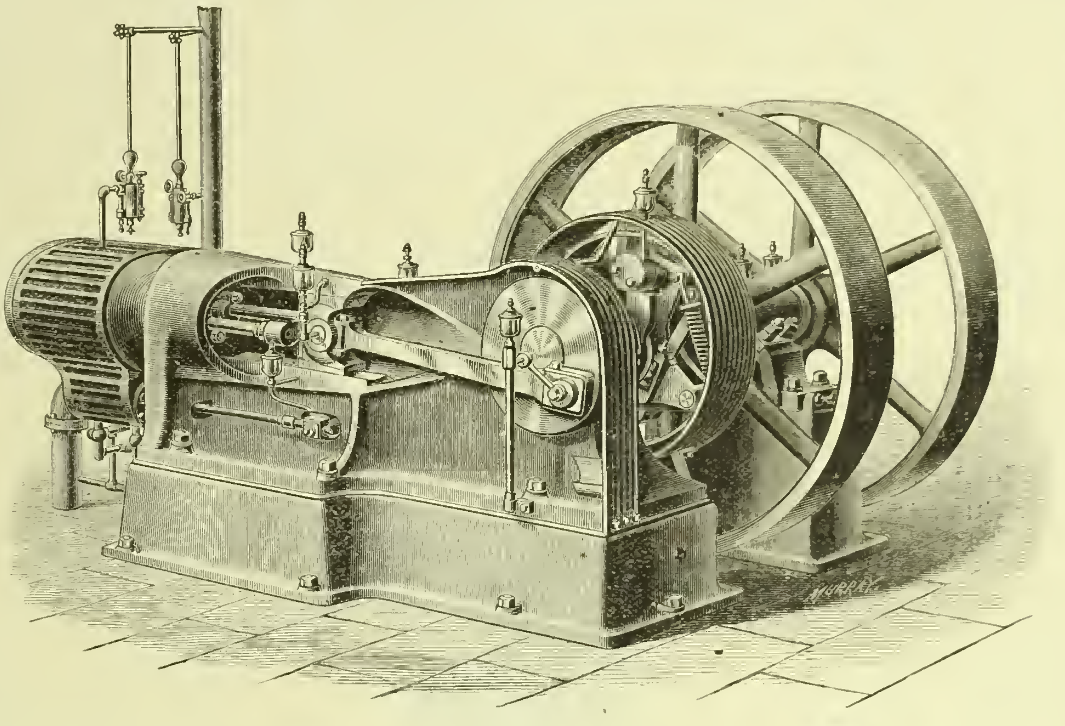
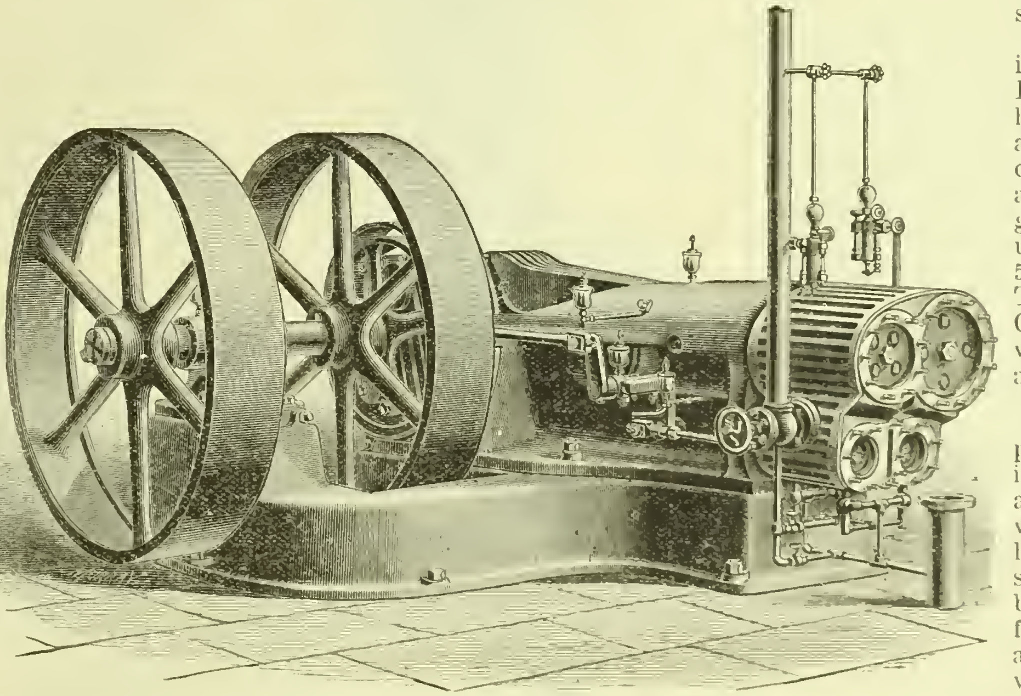
BECK TWIN-COMPOUND ENGINE.

THE Taylor Manufacturing Company, of Chambersburg, Pa., have recently brought out a new compound engine, which has some novel and desirable features introduced by Mr. R. M. Beck, the superintending engineer of the company. Instead of placing the cylinders one in front of the other, they are side by side with a common wall between, hence the name "twin." Each cylinder has its own piston, and both are attached to one common cross-head, which in turn is connected by one connecting rod to the crank pin. Pressure on pistons is regulated so as to entirely equalize the strain.





The valves are side by side beneath the cylinders, with a chamber between into which the exhaust from the cylinder is discharged through the port between the valves. The bonnet serves as a connection between the end of the valve chamber of the cylinder and the port of the receiving chamber; each end is fitted with a bonnet, thus making a very short distance for the steam to pass from the high-pressure cylinder to the chamber, from whence it passes to the valve of the low-pressure cylinder, and thence into the cylinder proper. The short distance the steam has to travel from one cylinder to the other prevents loss of pressure from radiation of heat, as certainly occurs through the ordinary long and exposed receivers connecting the two cylinders. The wall of exhaust receiving chamber next to the high-pressure cylinder is exposed to live steam before it enters the high-pressure cylinder, and helps to prevent loss of heat from the exhaust in the chamber. Still further protection is afforded the exhaust by passing it through the piston valve of the high-pressure cylinder, which is surrounded by live steam from the boiler preparatory to going into the high-pressure cylinder. The exhaust chamber is of such proportion as to receive the steam without back pressure and prevents unnecessary expansion of the steam before entering the low-pressure cylinder, the importance of which is readily understood by engineers. These compound engines are designed for electric lighting and street railway service, as well as for other purposes, especially marine, for which service a line of vertical engines is being designed, the advantages of compactness being important in marine work, particularly for yachts. They require no more space than an ordinary engine. They have no large receivers nor live steam superheating attachments, but are as simple as a single cylinder engine and therefore can be handled by any engineer of ordinary intelligence.

The makers will guarantee an economical performance of engine in regular service as given in the following tests, made at their shops with an engine of 8″ diameter of high-pressure cylinder and 13½″ diameter of low-pressure cylinder with 15″ stroke. In a 15 hour test, above engine developed 90 h.p. per hour on 2 lbs. of coal, and 24 lbs. of water per h.p. per hour, with boiler pressure of 100 lbs. Same engine, in test of same duration, developed 40 h.p. on 2½ lbs. of coal and 27 lbs. of water per h.p. per hour, boiler pressure 100 lbs. Same engine in 11 hour test developed 25 h.p. on 3 lbs. of coal and 35 lbs. of water per h.p. per hour, boiler pressure 100 lbs.

The last-named test is with a very light load; consequently the economy is .not so good as with full load, but under the circumstances the results are equally as flattering as with the maximum load.

The coal and water used in the tests were ascertained by the actual weight and measurement of same as supplied to the boiler.

The test was made with common return tubular type of boiler with plain setting, using good bituminous coal from the Cumberland regions. Feed water at 208 degrees temperature, and all live steam pipe covered.

The compound engine is patented by R. M. Beck, to whom patents have been granted and are now pending on center crank, marine, and all other types of engine. They are now manufactured in sizes from 50 to 500 h.p. by the Taylor Manufacturing Co., Chambersburg, Pa., with New York office at 22 Cortlandt Street.

◆

A JOURNAL, when properly lubricated, and if kept clean from grit, and not allowed to heat. will have formed on it a hard, smooth, glassy surface, which is the best possible condition for minimum friction, and, consequently, least wear. If it can be kept in that condition, it will run for years with almost imperceptible reduction in diameter, and outlast the other portions of the machine. It has been the opinion of many mechanics that this very desirable glassy surface was peculiar to iron, and that the surface of a steel journal would not "polish" in the same way. But an inspection of some locomotive crank-pins and driving journals. made of steel and of good proportions, shows that they attain as high a degree of polish as iron.—*Master Mechanic.*

POWER FOR NOTHING.

An Englishman who claims to be a relative of Mr. F. W. Webb, of the London and Northwestern Railway, proposes to use electricity for generating steam in boilers, and trials have been made of an apparatus designed for the purpose. Wires are coiled round a filling of asbestos, the combination making up a plug about four feet long, which is pushed into a boiler flue. About twenty of these plugs are used for a twenty horse-power boiler. The wires form circuits in which the asbestos causes a superficial resistance. When the wires are connected with an electric dynamo, and a current of electricity forced through them, the wires get white hot, and impart the necessary heat to the boiler. That is the inventor's theory of how it will work. We are puzzled to see what will prevent the wire heated to incandescence from oxidizing and burning up. But the inventors appear to have faith in some law of nature being suspended to make their visionary plans work successfully. The man insists that with ten horse-power of electrical energy converted into heat he can generate sufficient steam to supply a forty horse-power engine. This would be a very neat and convenient way of making something out of nothing. Those interested in the invention did not like to be told that they were working upon a perpetual motion scheme. The most surprising feature of the whole thing is that many sensible business men are ready to accept it as practicable, and to manifest their faith by giving it financial support.—*National Car Builder*.

No, they never do; but they have to pay their money all the same.

◆

Gas has been tried in lighthouses, but the results were not very satisfactory. Gas pipes will get out of order, and a lighthouse must be always in order. At the present time there are but three lighthouses where gas is used. They are near cities. One is at Alexandria, just below Washington. To provide against accidents a set of oil lamps is kept constantly in readiness. In one of the sounds on the North Carolina coast there are ten small lights which are kept supplied with gas. The gas is manufactured by the Government, and is compressed in tanks. The keepers go from light to light in a steam launch, hauling the gas tanks in a scow. These lights can burn ten days.

In New York harbor, on Dry Romer Shoal, there is an iron pier which supports a skeleton tower twenty-five feet high. The light on this tower is supplied with compressed gas from a tank which holds a ninety days' supply. The light can be seen eleven miles. It is the only structure of the kind on the coast. The cost, including the compressed gas apparatus, was less than $15,000, but the Board has not seen fit to duplicate it.

At some pier heads and breakwaters on the lakes a combination gas machine is used. It makes gas from gasoline, as needed, by an automatic contrivance. According to the size of these machines, they will keep a light going steadily, without attention, from thirty to ninety days. The keepers live on shore, and are required to visit these combination machine lights daily if the weather will permit, to keep the light clean and to see that the mechanism is in order. When a protracted storm comes and it is impossible for the keeper to reach the light the machine has been found to be reliable. It goes on making gas and burning it day after day.

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We are desirous of obtaining several serial articles for the coming fall and winter, and will thank all who have practical matter of this class to submit their copy. Essays are not wanted.

◆

In the '*Baltimore*,' U. S. N. cruiser, the people have a vessel of which they may well be proud. She is capable of very high speed at sea and long endurance.

EMERY WHEEL GRINDING.

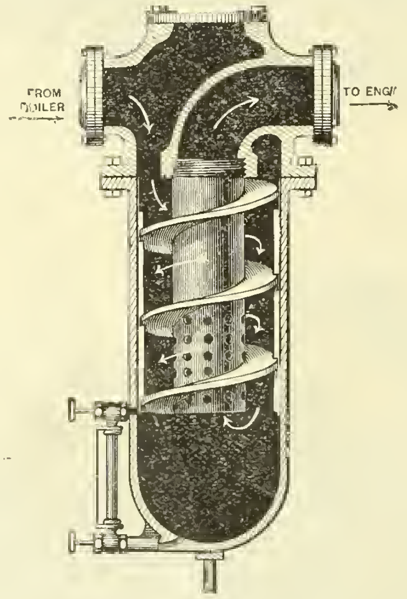
The president of an emery wheel manufacturing company in Pennsylvania recently delivered a lecture before the Franklin Institute at Philadelphia, and among other things compared emery grinding with filing as a method of removing and shaping metal. This is begging the question, because people do not file off soft metal nowadays. The file, as an instrument for shaping metal, has nearly disappeared from modern machine shops. The true functions and possibilities of emery grinding as a rough process, that is, for shaping soft metal, are pretty well understood, and have been pushed beyond its legitimate place. For "adjustment" or fine finishing, especially of hard material, the matter is different, but to compare with filing is no comparison at all.

For example, the lecturer employed diagrams to show the difference between grinding and filing notches in a plate. Such notches are either punched out or cut out, and in either case much cheaper than by grinding. As a general rule the removal of material is expensive in proportion as it is pulverized instead of removed in chips and pieces.

This is illustrated in working iron, wood, stone, or, indeed, any kind of material. When there is but little to be cut away, the waste may be pulverized, as in grinding; but when there is much to "come off," the larger the chips or pieces the better. Sawing out forms is an extreme. In that case the waste is removed in a single piece, only a thin kerf being pulverized. This is a law of cutting and shaping all kinds of material. Trueing or preparing surfaces, also cutting material too hard to be acted upon by "edges," is another matter, and is the true function of emery grinding.—*Industry*.

◆

ROBERTSON'S SEPARATOR FOR STEAM BOILERS.



Boilers which prime, or are short of steam room, give great annoyance to engineers by the water they deliver along with the steam, and which may be said truthfully to be matter in the wrong place. James A. Robertson, 45 Cortlandt Street, N. Y., has designed the appliance shown herewith to free saturated steam from the water held in suspension, and the construction is so plainly shown by the engraving that no explanation is needed. It is claimed to answer the purpose for which it is designed, and can be readily applied to any steam pipe at very short notice. Address Hine & Robertson, 45 Cortlandt Street, N. Y., for price list and catalogue of their engineers specialties.

◆

Etching is of two kinds—the bitten and the dry point. The first is simply an acid process by which the plate is bitten, or cut, by acid; the other is actually cutting the metal itself with a tool, so that it will hold ink.

MAKE AN AGREEMENT.

It is difficult to deal with men who will neither give nor receive a definite proposition looking toward compensation. If you meet a man who says "That will be all right; I guess we won't have any trouble about that part of it," there will be trouble on just "that part of it." If, on the other hand, you find a man who is always declaring, "You'll not lose anything by this; I'll see that it's all right," you may be sure it will be all wrong in the end. When two men of this sort get together, and the services are of such nature that to determine their exact value at the time of their inception is impossible, the end will be a misunderstanding, mutual dissatisfaction, possibly an estrangement. Yet there is no case in which a probable value cannot be got at. If you estimate the value of results as you plan them to happen, you can never be far wrong. If one cannot do that, he has no business to undertake to make contracts at all. It may be that there are times when a man may go into a business engagement without a definite idea of what his pay is to be, and there may be men who will always settle satisfactorily, but one is never safe to make engagements in this way. False modesty stands in the way of business arrangements. As an old merchant said once, "We are friends, and I trust will always remain so. When you are making an agreement for the purchase and delivery of goods, don't think of your feelings. Buy of me as you would of a stranger; consider your own needs and profits, and don't hesitate to buy where you can do best." It should be exactly this way in making arrangements for employment. Treat the matter simply as business, pure and simple. You can't afford to do business without making proper arrangements for all points. —*National Grocer*.

◆

A paragrapher recently made a sarcastic note to the effect that a Western justice of the peace had recently reversed the decision of the United States Supreme Court on the original package question. In our *Legal Decisions in Trade* column, a case is recorded where a Texas judge gave it as his opinion that an unskillful man, acting as an engineer, can recover damages if the engine breaks down and injures him. Succinctly and directly, the learned judge says:

"Impaired capacity to labor and follow a business or vocation is a proper element for damages in a case like this."

This is just a little curious; it would seem to the unlearned observer that if a man engages for the wages he receives to perform a certain kind of work that he knows is hazardous by reason of his ignorance of it, that he assumes all the risks.

◆

There are innumerable typewriters in the market of the one-hand class, where a pointer is moved over an index, the same as in the Wheatstone telegraph. Some of them are very useful, in that they are handy and do efficient work; but they are only suited to limited correspondence, and most of them have bad faults. In one the impression has to be regulated by a screw for every thickness of paper, varying from a postal card to "onion-skin" note. Some of them are hard to get the paper in, and equally as hard to get it out without soiling. Another one has a type form like a hammer-head, and strikes like one. The perfect one-hand machine is not made yet, but it will be some day. When it is let the makers of it do good work on it, not rat-trap work; too many of them are of this class now.

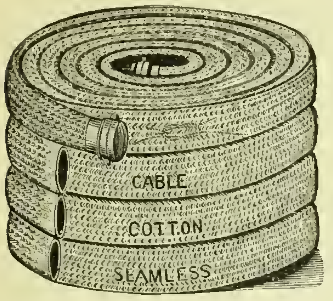
◆

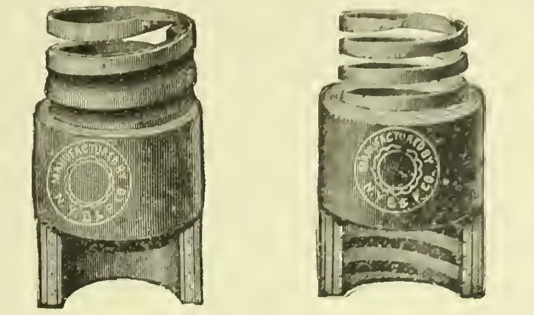
It is predicted by the builder of the '*City of Paris*' that the trip from New York to Ireland will soon be covered in five days. So it will in four days, if they only shorten up a little more on the starting points. The time for taking the record begins about fifty miles outside of New York, and the same distance outside of Liverpool; that means five hours cut off of the actual time.

FACTS ABOUT RUBBER HOSE.

RUBBER hose is stronger than that made of leather, but its principal advantage lies in the fact that it needs only to be hung up to dry after use, while leather hose must frequently be "stuffed," after the manner a currier finishes leather, only the stuffing must be forced inside of the hose, making the operation more difficult. For these reasons the use of leather hose is confined almost entirely to small country towns for fire purposes, where only hand engines are used, and where the volunteer firemen have ample time to devote to leather dressing. Among the first manufacturers in this line are the New York Belting and Packing Company, of New York City, the oldest, as well as the largest, manufacturers in the world of vulcanized rubber goods for mechanical purposes. The hose made by this firm, some brands of which are illustrated herewith, can be thoroughly relied upon, and is well worthy of notice.

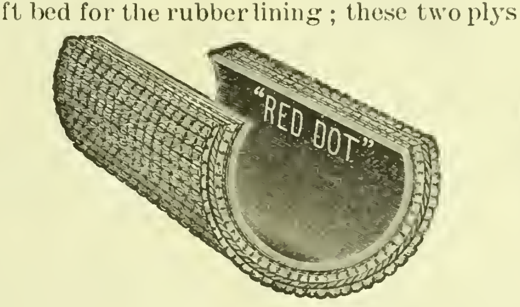
A few words as to its manufacture. In the making of rubber hose by this firm, special care is taken in the selection of the raw rubber for the goods to be manufactured, different mixtures being used and the treatment varying, in order to obtain the exact condition which will allow the rubber to be applied to and incorporated with the duck, to give the greatest amount of strength. The lengths and widths required for making each piece of hose are cut from long strips, and then wrapped around long mandrels, so that the freshly cut edges of rubber will just meet. The rubber is then in such condition that, on the edges being pressed together, they unite so firmly as to hold with great tenacity. To make the joints of equal strength with the other portions, a thin ribbon of rubber is pressed against it, and the mandrel revolved against other cylinders, in which powerful pressure and the requisite heat makes firm and compact the entire fabric. This mandrel remains in each length of hose until after the subsequent vulcanizing process has been completed; but to prevent the rubber sticking to it, the rubber is coated with a powder. The last operation is the vulcanizing. It consists in subjecting the rubber, mixed with its proper proportions of sulphur, to a certain degree of heat for a special length of time, the heat and time varying according to the mixture, the kind of rubber, and the article to be made. This is the way in which all rubber hose is generally made. The popular "Cable" Cotton Hose, also used largely for steam purposes and in the principal fire departments of the United States, is made of rubber lined, extra heavy seamless cotton fabric, circular woven, in a manner differing radically from all other hose. This has won for it a reputation unequaled for enduring great pressure and long, severe service, without bursting. It has a double looped covering, duplicating the wearing surface, and is the only hose that can be so made. To prevent decay and rot, the "Cable" is treated with well-known antiseptics, under a patent process, and it is the only fabric hose so prepared. The best Para rubber is used in the lining, which is extra heavy and smooth bore. It is woven solid, in plys, and with a jacket or double for the different service required of it. The rubber suction hose illustrated is a new invention. The walls of this hose are stiffened and strengthened by a galvanized iron spirally-wound coil, which is embedded in the rubber entirely out of sight, so that it cannot be acted upon by water or other fluids, nor displaced by any internal pressure, when used in connection with fire-plugs or hydrants. The interior or bore, being perfectly smooth and even, water will pass through it with less friction and more rapidly than through the old style suction hose, in which the exposed metal rings or spiral coil gave it a rough, uneven interior, that considerably retarded the passage of water through it. It is also stronger and much more flexible than the old style suction hose, its flexibility being so great that a 4-inch "Smooth Bore" can without injury be coiled within a circle three feet in diameter. In pumping pulpy or semi-fluid matter, such as would clog and render useless the old-style suction hose, the "Smooth Bore" will prove very useful,





Hose made expressly for steam fire engine use, will stand a pressure of over 400 pounds to the square inch. It is of extra quality, and one of the oldest brands upon the market. It is composed of the best Para rubber and duck. This Para rubber is the strongest and very best known, and will not crack or harden. The duck used in the manufacture of this hose is made to order from the best long staple cotton, a fabric of great strength, and is chemically treated with vaporous carbolic acid by a patent process to prevent mildew. The "Test" is especially valuable where a heavy hose is needed.

Another brand lately put upon the market is the "Herkner" multiple red-dot cable hose. It is what is called a jacket hose, and the advantages afforded by its use are clear water-way and no friction. The loose jacket is woven solid on the inside of the hose in finer threads, making an even inner cushion or soft bed for the rubber lining; these two plys are firmly united into one solid base, increasing the strength, making the lining longer lived, and forming a perfectly smooth waterway, thus overcoming the friction of the corrugated interior of other cotton hose. The outer plys or covers can be worn away without visibly affecting the inner fabric. It is distinguished from other hose by the red dots across the surface—the patent trade-mark of the manufacturers.



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A DEALER in millinery has just learned the pecuniary peril of free and easy correspondence about a rival in business. He wrote letters affirming that their mercantile credit was extremely doubtful. They got the letters and began suit, asking for $15,000 damages. It cost him $600 for legal and other expenses. Altogether the correspondence cost $4,100.

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THE people of the United States during 1889 smoked 3,955,955,773,722 cigars.

SAME OLD FALLACY.

HERE is the same old fallacy—untruth is the harsher term—repeated in Goodeve's "*Text Book on the Steam Engine*," page 187; he says: "Clearance will modify the form of the expansion curve by removing backwards (?) through a small space the zero line of volume, and if the steam be completely exhausted from the cylinder during the return stroke the effect of clearance is to waste a quantity of steam during the double stroke. But inasmuch as it is possible to compress a portion of the steam in the cylinder during the return stroke, the loss above referred to may be greatly or perhaps wholly eliminated. In such a case the work expended in compression is restored again during expansion, and the steam spring is continually reproduced without waste."

Is it indeed? Then we must get power for nothing.

◆

THERE are in the service of the United States 1,150 lighthouse keepers. The average salary is $600, but by a system of grading some get as high as $1,000. Discipline is very strict. For two offences the penalty is immediate dismissal. A keeper found under the influence of liquor is not only dismissed from the service, but he is ejected from the lighthouse as soon as possible. The keeper who allows his light to go out is dismissed, no matter what his excuse may be or how good his conduct may have been. These are the two unpardonable sins. The keeper is expected to stay by his light as long as the lighthouse stands. The Sharp's Island lighthouse in Chesapeake Bay was lifted from its foundations, thrown upon its side, and carried away by the ice. The keepers had a boat and might have made their way ashore. Instead of looking out for their own safety they remained with the lighthouse wreck, floating about until it grounded. Then they carried ashore the movable portions of the light, the oil, the library, and even the empty oil cans. They were drifting at the mercy of the ice cakes, and without food or fire for sixteen hours. The keepers of another lighthouse, becoming alarmed at the ice, abandoned their post and went ashore. They were immediately dismissed. It made no difference that the ice rendered the light unnecessary. The offence was the same. The two keepers who had clung to the lighthouse that floated away were promoted to the lighthouse which the two unfaithful keepers abandoned.

◆

THE officers of the '*Pensacola*' boast that on that vessel's recent cruise of 1,710 miles she made an average of nearly seven knots an hour, using nineteen tons of coal daily and encountering a head wind throughout the entire trip. They think that this is pretty good time, considering the '*Pensacola's*' old engines and faulty bottom, and take a certain satisfaction in comparing it with the recent transatlantic cruise of the '*Boston*' and '*Atlanta*,' when those ships steamed an average of eight knots, with a one-knot breeze in their favor all the way, using thirty tons of coal, and having the added advantage of high-powered engines and a clean bottom.

Yes; but high-power engines are not an advantage at low speeds. "On the contrary, quite the reverse."

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THE dangers of the Florida Reefs and the numerous wrecks constantly occurring have made wrecking a very profitable business for the Indians and the white inhabitants living on the keys and mainland. The wreckers save all property possible, convey it to Key West in large sloop boats, have it appraised before the United States Court, and obtain about 50 per cent. salvage money. It is a common byword among seafaring men that Key West wreckers can strip a ship to her very bones. They leave nothing. Notwithstanding many ships are continually piling up on the Florida Reefs, not a few but could have been saved by timely assistance.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

THE LOG OF THE 'BUTTERCUP' WRITTEN UP BY THE LADY CHIEF ENGINEER.

Editors ENGINEER:

I enjoy the calm, beautiful, early morning of midsummer. I like to sit on the wharf when the tide is full and about to change, and watch the lessening play of the eddies, as they bear hither and thither the flotsam or jetsam, likening them to the currents and eddies of our lives; the unconscious, irresistible influences that so control life's progress. How welcome the warm sun—its rays so permeating! The faint perfume of the morning air instills a delicious languor; even the purple, gossamer-winged bee is drowsy, his song is low and surly. The pearly clouds, edged with pale gold, are motionless, becalmed; they seem to the dreamer's eye like mighty castles crowning the slopes of fairy land. The shipyards on either hand, teeming with activity, remind of reality with their musical hum—typical are they; thus blends always the real and the ideal—the earth and the heaven of existence. The old Kennebec, with its thirty feet of water at low tide, with its almost unequaled scenery, which from its mouth to Bath, twelve miles, is rocky, wild, bold and picturesque; from thence upwards, growing more and more beautiful in its varied picture of bluffs, woodlands cultivated farms with their green intervales, rolling and hillocks; all historical, with living ideals of Indian life. This grand old river in its mighty power lies these mornings a sleeping monster, awaiting only the south wind's breath to awaken its forces and generate a fascinating resemblance to old ocean itself. Here, at Bath, I have repeatedly seen it lashed into such fury by a southwest wind against an ebb tide, that tow and ferryboats would put their bows under at nearly every plunge, and three and four masters roll very perceptibly while at anchor. Ah! this is life. This is the time to be out in *'Buttercup,'* and with hand on throttle, fight bravely the rolling tide. I have stood watch at the wheel, enveloped in rubber clothing and 'souwester' repeatedly, during these times, when the spray blown from the top of the waves was three feet in height, and so dense as almost to be blinding, and thus have sung grand old songs at the top of my voice. To enjoy nature in this way is inspiring. I've never been completely swamped, but have come mighty near it many times, and that, too, with the bilge syphon constantly working full power; once off Marblehead, when the yacht *'Mayflower'* had her trial trip.

I've traveled this country over, and know the Mississippi from its source to its mouth. I know the great Lakes and the St. Lawrence. I know the rivers of the South, but nowhere have I found so much that is grand, picturesque, and soul inspiring, beautiful nature in all her varied moods, as in this summerland of Maine, this Kennebec valley. I love it. Every nook and cranny of the winding river is familiar to me. Every rock, tree, and shrub on its shores are familiar objects. I've photographed the best of them. Consult the chart, Messrs. Editors, and you will see how we can make trips East and West and South and North, for thirty consecutive days and visit new places of interest each trip. In '*Buttercup*' I can visit ten summer resorts in ten consecutive days, leaving at 7 A. M. and arriving home at Bath before sunset. Yachtsmen in search of the picturesque are finding this out; canoeists also. Steam launches from all quarters are familiar objects up and down the river. It needs but a few birch-barkers to complete the picture, and they will surely come ere long.

It was on one of these ideal mornings that I sat on the wharf musing, communing with nature. '*Buttercup,*' with her glistening mahogany sides, rode quietly at her mooring. "*Eruditus*" was busy aboard in cleaning and polishing, an occupation that he enjoyed. My husband was at work with a monkey wrench on some repairs in which I took no interest. The smoke-stack, I noticed, was removed from the boiler, and I also noticed a passing towboat now and then, the swell created by it, its swash against the wharf, and the graceful riding of the swell by our pretty boat.

My dreamy musing was rudely broken in upon by my husband saying to me:

"Won't you go down to the iron works and get a $\frac{3}{8}$ inch nipple for this jet in the stack? I have twisted off this one."

"Yes," I replied, but I said it reluctantly, for the Iron Works were a good mile away, and I was not in a walking mood and did not care to be disturbed, but off I started. The morning was warm, and, ere I reached my destination, it seemed I had tramped two miles instead of one. I succeeded in my errand and duly returned. Scarcely had I resumed my former comfortable seat ere I was again requested to go for a second time on the same errand. My husband, though skillful as a physician, was a poor hand in practical mechanical work; he had "set up" too hard on the nipple, and had twisted it off, as he had done the previous one. I saw he was a little ashamed at his want of skill, so I kept back my criticism and started off a second time for the Iron Works—two miles already walked, and two miles more to do before I could snuggle down in my cosy quarters on the wharf for a lazy loaf at my ease, "inviting my soul!" To tell the truth, I was a little nettled to be called upon a second time for a duty I considered was more in the province of Eruditus; but, when my husband requested me to go a second time on the errand, I noticed that my son was very, very busy polishing, and oh! so quiet, not even apparently noticing his father's request to me; but, ere I had gone many steps I turned, like Lot's wife, for a farewell look.

Ye Gods! What did I behold? "*Eruditus*" was rocking to and fro, slapping his knees in laughter at my expense, while my husband was lying back at his ease, lighting his pipe for a good smoke while awaiting my return. My first impulse was to rebel; the joke was on me. I would not let them know that I was aware of it, but decided I would pay them back with interest, for I enjoy a good joke, give or take.

On my way down-town I stopped over for an ice cream to calm my irritated nerves, then finished my errand, and returned pretty well heated up. At my first view of the boat, as I came around the corner, I beheld those two loafers stretched out under the awning enjoying the breeze that was beginning to ripple the calm water. I had not proceeded many steps farther ere life in all its activity seemed to reign supreme on board; my husband was hammering away at something on the floor of the boat, "*Eruditus*" was overhauling rope from the same quarter for all he was worth. It was evident that they had seen me, but I pretended not to notice their zeal and refrained from comment. Seeing that I had returned, "*Eruditus*" jumped into the tender and soon ferried me aboard, talking rapidly all the while, inviting my attention to the result of his morning's work. He was in the best of spirits, exuberant and witty, saying:

"You look tired and warm, but it is such a lovely morning for a walk (accent on "lovely" and "walk,") you will have such a good appetite for dinner. I've worked hard, too, and am awful hungry."

Said my husband: "You are very kind to do this service, it is a great help for me. I've been much annoyed by the hitch, hitch of these repairs; I have repacked the glands, and disconnected, cleaned, and reset the crank pin brasses, quite a job; no thump or pound will annoy us as it did yesterday coming home."

"Yes" I said, "you must have worked hard! very hard! it must have taken you twenty minutes or so, to do all that hard work. I've been gone over an hour and a half on each trip, three hours in all; here's your nipple, now see if you can twist this one off while I help myself to a bottle of beer. My gracious, isn't the day a hot one, and how deliciously cool this lager is! By the way, what were you pounding so hard at when I came in sight?"

I noticed that "*Eruditus*" jumped quickly behind the boiler at this remark, but had no time to consider its significance; for looking towards my husband, who was working on the steam-jet connection, I heard him exclaim!"

"By jove, I've twisted it off again!"

This was too much for "*Eruditus.*" He burst into loud laughter, with the pent-up effects of the joke on me, and this third one on his father. He was fairly convulsed.

"That's it!" he shouted while the tears streamed down his face; "that's it! keep on twisting them off! Mother will go and get another one while we are working so hard! ha-ha-ha, he-he-he; giggle giggle."

"Not much," I exclaimed, as I looked into my husband's sober face. "Mother does not go on any more fools errands to-day," and then to my husband:

"What on earth are you thinking of, to use so large a wrench in setting up so small a nipple? Didn't the two previous lessons teach you anything?"

At this "*Eruditus*" roared again, and soon we were all laughing.

My husband swore a mild oath or two at his want of skill, and then turned to me and said (in his blandest tones):

"Won't you please go and get another nipple?" This audacious request, at such a moment, completely sobered "*Eruditus.*" He listened for my reply. I did not, at that moment, completely sense the amount of cheek required to support such a request, for an idea struck me, as it were, and I was mentally debating it. My husband continued:

"I don't care to go down-town all covered with grease and in this old suit. If you will go, I will make you a nice present next Christmas?"

For a second time my son was convulsed; he fell off the seat on to the flooring of the boat, and rolled and groaned in his delight.

"Why not send '*Eruditus*?' I asked.

"Oh," replied my husband, "he's no good on errands unless you pay him half a dollar for ice cream; besides I have work for him here."

"Yes," I replied, "coiling rope or pounding iron." Then we all laughed, but mine was a grim laugh. My mental plan was completed, and I said:

"Yes, the promise for a present so soon as next Christmas is too much for me to withstand, I will go!" Suiting the action to the words, I jumped into the tender, and announced my intention to row to the Iron Works instead of walking, and my parting salute was: "Good-bye you lazy loafers; you think you've got another joke on me, but you just wait until I return and then see how nice that dinner will taste." (Groan from "*Eruditus.*") "I will get the nipple," and then dramatically, "I go, but I return in about three hours." I heard "*Eruditus*" say in an undertone to his father:

"She's got the best of us, as she always does. You had better call her back; I'm awful hungry," and then my husband hailed to me: "Good bye. Be quick, and return so we can go fishing off Seguin this afternoon; don't be joking, now, but hurry up."

I knew I had the advantage of them and chuckled; I knew there were no kindlings aboard to start a fire. I knew there were no prospects of a passing boat picking up my "forlorn companions" at this time of the day; there was only one way to get ashore, and that was to swim for it, with clothing on; this I knew they would never do, so I chuckled, and enjoyed the joke on the jokers.

A three mile an hour tide in my favor soon helped me to the Iron Works.

A smile wreathed the face of the clerk as I explained the reason for my third appearance on the same errand, as well it might. I had no reason to smile, however, when I considered my row back to our mooring against the tide. I thought it over well and then left the tender at the wharf and walked back. I found my family as I had left them, working hard at loafing; but seeing me returned, they soon expressed desire to get ashore, and asked me to hunt about and get a boat and come to their aid.

"Yes," I said, "you want your dinner; that is laudable, but I see no other way for you to get it but to swim for it, and be quick about it, for I shall not wait long!" Then I could see that they debated over my proposition, finally I noticed them engaged in tying ropes together. This finished, "*Eruditus*" removed his clothing, tied the end of the rope about his waist and jumped overboard and swam for the shore. After much hard work with so much rope across the current, he finally landed, and soon '*Buttercup*' was made fast to the wharf.

The meeting between us was not as hilarious as the previous one. "*Eruditus*" was very sober; his father was smiling, but dignified. It was my turn to laugh, and I improved it, but my two grim and hungry companions saw nothing to amuse them; they had had their laugh. As I looked down into the boat from my position on the wharf I could not but help noticing how orderly everything was; evidence to me that they had done their best to kill time. They were so thoroughly beaten at their own game, so discomforted, yet so gentle, that I took pity on them and heeded their request to say nothing about it—to keep quiet and call it square. I have, until this writing.

It's well for a woman to enforce her authority at times, especially with a fourteen year old son. Since the above experience I find I have not been so much of a passenger aboard *'Buttercup.'* I have not been ordered about so much by the captain and crew. "*Eruditus*" always considered me a landsman, and treated me as such, ordering me around and about to suit his convenience; 'tis different now. However, we did not lose our good dinner. An hour or so after we started fire for an afternoon run to Fort Popham, a summer resort at the mouth of the Kennebec. No breakdowns, no mishaps, no incidents of account occurred on the trip. So my story necessarily ends. MRS. BUTTERCUP.

Boston, Mass.

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IN THE MATTER OF ALIEN ENGINEERS.

Editors ENGINEER:

I was very much pleased to read your advice, "*Taking the Bull by the Horns,*" in the last issue, and, as you say, the remedy lies in the hands of the members of the various associations, it is of no use writing or talking about the matter, but collect the evidence, act upon it before the courts, and obtain a conviction. A few cases so settled will stop this nefarious practice. I would not advise any association to rely upon the local or general inspectors; obtain their support, if possible, but push the case through the courts themselves. There was one case of an engineer's license being granted to an alien at Savannah; he had never resided in the country for one consecutive month in his career; this was reported to the authorities, accompanied by affidavits, yet nothing has been done in the matter, as the delegates to our last two conventions well know; so I take this as a proof that it is no use relying upon the inspectors.

When an association knows of a case, appoint a committee with power to act and the requisite money to back them up. Prove the case and push for a conviction; then, and then only do you do your duty.

Should No. 13, M. E. B. A., get on to another case, with as good proofs as she had in the late ones, it will be pushed for a conviction to the full penalty that the law allows; but I think aliens will give Philadelphia a wide berth in the future.

Philadelphia, Pa. BELL CRANK.

◆

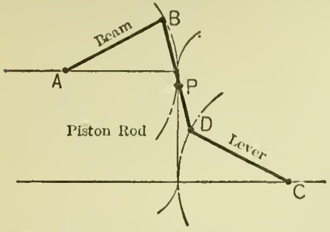
PARALLEL MOTIONS.

Editors ENGINEER:

Please say how the old parallel motion for beam engines was constructed, and how it works. Who invented it? STUDENT.

New York.

[Watt invented it, and the diagram shows how it works. The beam center is at *A*, and the end of the beam describes an arc about it. The lever *D* (radius bar) has its center at *C*, and its end describes an arc in a direction opposite to that of the beam. These two—the beam and the lever *D*—are connected by the link *P*, whose center is at *P*, and to which the piston rod is jointed. Consequently it moves in a straight line between the radii of the beam and radius bar. This motion is not available for any but short strokes and long beams; if carried too far, the link *P* dodges at top and bottom of stroke, as shown by curved lines.—EDS.]



◆

PRACTICAL TESTS OF A STANDARD HORSE-POWER.

Editors ENGINEER:

I was recently at a coal mine where two horses are used to hoist coal out of a shaft 150′ deep. As the weight of the cage and car going down balance the weight of the cage and car coming up, the weight of the coal represents the amount raised by the horses. The horses hoist 1,000 lbs. of coal in two minutes. 150×1,000=150,000 foot lbs. of work done in two minutes by two horses. 150,000 ÷ 2 = 75,000 foot lbs. of work done in one minute by two horses. 75,000÷2=37,500 foot lbs. of work for each horse per minute. The horses could not keep this up all day. I think they would not average over 20,000 foot lbs. per minute all day; but I think 33,000 foot lbs. per minute is near enough to a horse-power for all practical purposes.

Ottawa, Ill. ALBERT H. HALLADAY.

◆

DAVID B. JACKSON.

At a regular meeting of M. E. B. A. No. 50, held at their rooms, 287 Hudson Street, N. Y., on the evening of June 10, 1890, the following preamble and resolutions were adopted :

Whereas, It has pleased Almighty God in His infinite wisdom to remove our esteemed and faithful co-worker, Bro. David B. Jackson ;

Be it resolved, That while we bow in humble submission to the decree of the All Wise, and our hearts are touched by sorrow, that we testify our sense of loss in the decease of our lamented brother.

In the person of David B. Jackson were centered those manly attributes which made him a faithful employee, a wise counselor, and a generous friend. Always kind and courteous to those with whom he was associated, he leaves behind him a record unsullied by act of wrong. As we esteemed him in life, so do we mourn at his demise. To his family in their deep affliction do we tender our sincere condolence.

Be it further resolved, That in memory of our departed brother we drape our charter and altar for a period of thirty days ; these resolutions to be spread upon our minute book, and a copy transmitted to the sorrowing family.

ANDREW M. LESTER, Pres.
G. MARION WHITE,
JAS. H. SIPPERLY,
WM. S. HOLTON,
Committee.

◆

IN MEMORIAM.

BROTHERS of the M. E. B. A. everywhere will be pained to learn of the demise of Miss Josephine A. Stetson, affianced wife of Brother George Uhler, National Treasurer, M. E. B. A., and chief engineer of the steamship '*El Paso.*' The sad event occurred on the evening of the 13th inst. The deceased was a most lovable lady of rare personal qualities, and passed away at the early age of twenty-five years. Brother Uhler will have the sincere sympathies of all in his sad affliction.

◆

THERE can be no doubt but that water, at the instant it is condensed from steam, is particularly active in dissolving glass—much more active than after it has stood for a time. We have good evidence of this in our own experience. In fact, at the present moment the writer has before him a glass tube one-third of an inch in diameter internally, and 26 inches long, that was used for condensing steam to supply a laboratory with distilled water. Although it was used only three hours, it is very perceptibly corroded by the hot water of condensation.—*The Locomotive.*

◆

THERE was a bad time in Bridgeport, Conn., recently. "The engineer in a shop was called to do some carpenter work in a remote part of the works, and during his absence the governor balls blew off! The shock was felt all over the shop, and the inmates were in fear of a boiler explosion, as they crawled out of every available outlet. The engineer ran back to the boiler and adjusted matters, and it is said that but for his prompt action there would have been an explosion, with serious if not fatal consequences."

By the local reporters, of course.

LATEST LEGAL DECISIONS ON TRADE.

REPORTED FOR THE ENGINEER.

[WE shall until further notice publish the latest decisions in courts of last resort upon topics of general interest to our readers. From these decisions they will be able to judge in a measure of their own chances in similar cases.]

Liability of City for the Condition of Wharves.—Where one had been in exclusive occupancy of a certain portion of a public wharf, paying a monthly rent for the same, and kept moored by the wharf two floats on which he carried on the business of a coal-dealer, the city removed certain of the check posts to which the floats were attached and did not replace them. He made no complaint when the posts were removed, nor did he request the city to replace them. His floats being carried away by high water, he cannot recover of the city on the ground of their negligence in removing such check posts. —*Jackson* v. *City of Allegheny, United States District Court, Western District of Pennsylvania,* 41 *Fed. Rep.*, 886.

Collision at Sea.—Where a schooner which showed no lights was run into by a steamer, the vessel failing to show the statutory lights is in fault, but that fact does not relieve the other vessel, if under the same circumstances she would have been held liable before the statutory rules were in force.—*The City of Savannah, United States District Court, Southern District of New York,* 41 *Fed. Rep.*, 891.

Liability of Consignee for Demurrage.—Where it is the custom of the port that when several vessels come to the same consignee, the consignee discharges them in turn, and he is not guilty of a failure of his duty in declining to discharge two at the same time, even though there be sufficient room at the wharf to do so.—*Bartlett* v. *A. Cargo of Lumber, United States District Court, Eastern District of New York,* 41 *Fed. Rep.*, 890.

Claim for Freight Lost by Unconditional Delivery.—A cargo of lathes sold by the consignee to the claimant before arrival is discharged without notice to claimant of any lien to claim on demurrage, it being customary in the port of New York to discharge cargoes of canal boats and demand freight and demurrage afterwards. The purchaser transported the lathes from the wharf to the lumber yard. The delivery being unconditional, the lien was lost. —*Egan* v. *A Cargo of Lathe, United States District Court, Southern District of New York,* 41 *Fed. Rep.* 830.

Liability of Ship Owner for Hospital Charges of its Seamen.—The owners of a ship are liable to the New York quarantine commissioners for one of its seamen's expenses at the hospital, who were sent there ill with the fever and remained there 134 days, even though he was not ill with the fever for more than one-half the time —*Anderson* v. *Wensleydale, United States District Court, Eastern District of New York,* 41, *Fed. Rep.* 829.

Relationship of Fellow-Workmen in Unloading Vessels.—Plaintiff was employed by a firm of stevedores who had a contract to load a vessel from the dock of the defendant; the defendant furnished a man to do the signaling for hoisting and lowering the packages of freight; by his negligence the plaintiff was injured. Such workman of the defendant was not a fellow-servant with plaintiff.—*Sanford* v. *Standard Oil Co., Court of Appeals of New York,* 24 *N. E. Rep.* 313.

Master and Servant—Doctrine of Fellow Servant.—Where the evidence is that the track inspector of a railroad company and his gang went over a curve about two weeks before the accident occurred, and examined it carefully and repaired it for service, and where it appeared from the evidence, if the railroad company was guilty of negligence at all it was in regard to the condition of the track at this point, and the engineer who was injured in the accident cannot recover, as the proximate cause of the injury was the negligence of a fellow-servant.—*Burrell* v. *Gowan, Supreme Court of Pennsylvania,* 19, *At. Rep.* 678.

Fellow Servant in Unloading a Vessel.—The captain of coal boat who managed the guy rope, while a stevedore, engaged by the consignees of the coal was unloading, did not pass under the control and become the servant of the stevedore, and the boat owners are liable for an injury to one of the stevedore's men who is injured by the captain's negligence in managing the guy rope.—*Kilroy* v. *Delaware & H. Canal Co., Court of Appeals of New York,* 24 *N. E. Rep.* 192.

Fixtures as between Buyer and Seller.—A steam engine and boiler situated in a shed attached to a two-story building used as a mill, the shed being so constructed that the engine and boiler could not be removed without tearing a part of it down, and a mill attached to the land in the usual way, and operated by the engine are fixtures and pass with the land, unless specially reserved in the deed.—*Horn* v. *Smith, Supreme Court of North Carolina,* 11 *S. E. Rep.* 373.

Discharge of Servant for Drunkenness.—Under a verbal contract with the defendant, the plaintiff was to cut and trim certain stone work, and if he got drunk or neglected his work, he should be discharged; it was alleged that he did get drunk and was so discharged; both of these statements were contradicted, and upon a trial of the case evidence should have been admitted that the foreman of the defendant had made declarations to another person before the plaintiff discharged, that the contract would be at an end if he got drunk again, as affecting his credibility.—*Mallonee* v. *Duff, Court of Appeals of Maryland,* 19 *At. Rep.* 708.

Right of Common Carriers to Limit their Liability.—A stipulation in a bill of lading that the valuation as agreed upon and named in this shipping receipt, is distinctively understood to be the valuation that shall cover loss or damage from any cause whatever, does not relieve the carrier from liability for the actual value of the goods when their loss is occasioned by its negligence.—*Pennsylvania Ry. Co.* v. *Weiller, Supreme Court of Pennsylvania,* 19 *At. Rep.* 702.

Interest of Owner under the Limited Liability Act.—The United States statutes provide that the liability of the owner of a vessel for any loss, damage, or injury by collision done, occasioned, or incurred, without the privity or knowledge of such owner or owners, shall in no case exceed the amount or value of the interest of such owner on such vessel and her freight then pending. Under this statute the real value of the vessel in fault, is her value without regard to liens upon her at the termination of her voyage upon which she negligently caused the injury complained of.—*Kiernan* v. *Leonard Richards, District Court of the United States, District of New Jersey,* 41 *Fed. Rep.* 818.

◆

A CHEMIST recently thought he was on the track of a discovery which would bring untold wealth. He actually succeeded in manufacturing from the refuse of a gas retort a perfect emerald, and undertook to produce other precious stones by similar means. Unfortunately, however, it was discovered that the emerald cost to produce ten times as much as a similar natural gem could have been bought for in a jeweler's shop.

Yes, yes; and when emeralds can be made by the ton no one will want them and they will have no more value than a ton of any other stone.

◆

ACCORDING to a recent invention, injectors are unnecessary, and water can be forced in, or will run into, by a system of piping, the boiler directly. This seems to somewhat nullify the "vacuum" theory, which many hold is the cause of the action of the indicator. It is not based upon the gravity or water column system, but is a very simple and obvious arrangement.

◆

THIS is cut from a New York daily paper

> Engineer—Wanted, for brick yard; must be thoroughly competent and have steam at daylight; (German, and one who can do a little blacksmithing preferred;) wages $12 per week and board. Address Engineer.

"Daylight" occurs at about 3.40 A. M. in this latitude at this season.

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Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XIX. NEW YORK, JUNE 21, 1890. No. 13.

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EGBERT P. WATSON.

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OF DOUBTFUL UTILITY.

THERE are many philanthropic persons extant who are trying to do all the good they can to their fellows who are not so well off in worldly goods as they are; and, certainly, anything tending to thrift and prudence among mechanics should be encouraged. As a rule, they are not provident; neither is the average man, for the matter of that, whether he be a mechanic or what not. They earn their money by hard work, and there is not much left at the end of the month, after the necessaries of life have been paid for. Then, when the time comes that jobs fail, or men fall sick, their lot is a hard one.

A form of practical insurance is under advisement in Boston, in which a large portion of the people should be interested. A workingman is often thrown out of employment and reduced to distress because he is unable to provide for his board while out of employment. It has been suggested that a people's mercantile company might be formed, which would undertake to provide board and lodging with land lords at the rate of $4, $5 or $6 a week, on such terms that, after one month of regular payments, one week's board at half-pay might be placed to the credit of the interested party, so that if he were out of work, or sick, or otherwise disabled, he might not be brought to discomfort because he could not pay his board. At this rate, in six months a man would be entitled to one and a half month's credit for board, and in one year to three months' credit for board, which, at half rates, would only cost him the price of one and a half months' board anywhere. This plan, if it can be carried out, would be a great relief to hundreds of working people who are suddenly disabled or compelled to be idle. It would be impossible for anybody to fall rapidly in debt to such a company, and only in cases of extreme misfortune would persons be willing to surrender their certain insurance of food and lodging, which would grow larger as the years rolled by. A company of this kind would need to have a responsible backing in order to secure public confidence, but though it has never been attempted, it could easily be conducted on the basis which is common to similar undertakings. Payments would be made to landlords the same as now, and the company, after collecting a twenty per cent. discount every week for a month, could afford to give one week's credit, and do business on that basis. The credits would not be transferable except by consent of the company of directors, and would be dealt with by them in the same manner as if they were a life insurance policy. When such a company was established its range of restaurants or lodging and boarding houses would be such as to meet the wants of all classes of people. This is a system of co-operative effort, but it would be a company that could accumulate capital and increase its resources in proportion to its membership. It would thus be a safe investment for individuals, without involving them in any personal responsibility beyond what their regular payments would demand. This organization is not yet in existence, but it is one of the first practical suggestions for self-help which has sprung out of the movement for Christian socialism in Boston, and when it is properly developed and brought into shape, it looks as if it might meet a present and pressing need among people who are not forehanded and are not accustomed to making investments for themselves.

This is from the Boston *Herald*, and we fear the obstacles in the way of such a scheme are insurmountable. Workingmen are not ready for it yet. They very greatly distrust anything which has any co operation attachment, and very much dislike any paternal interest in their domestic affairs, so to speak. Here and there a weak brother might fall in with it, but the number of these are so few that the scheme would fail. A mechanic likes to save his own money, and does not wish anyone to do it for him.

◆

INVESTIGATING SCIENTIFIC SUBJECTS.

BEFORE men plume themselves much upon their accomplishments and their achievements in science, it is well enough to remember how much indebted we are to other men who have gone before. Not a single investigation of any kind can be carried on without copious reference to the work and the discoveries of previous experimenters. This reflection is brought about by reading a recent paper upon how to conduct a certain investigation in engineering, from, as the author states, a new basis. About every other line of it contains a reference to Clark, or to Rankine, Clausius, Hirn, Carnot, and who not! Really, the paper, which we do not point out specifically, is a review of the work of other men as applied to this particular subject, and in no sense the work of the putative author. Whether the applications apply does not concern us at the present; but it is hardly the thing, from our point of view, for a writer to rehash or to repeat the discoveries or the methods of well known experimenters, call it by a sounding title, make it bristle with unfamiliar mathematical characters, and tack his name on it as the author. This is in no sense technical work, but is simply a more or less valuable recital of mechanical maxims upon any given subject. Too many such papers are read before engineers' meetings, and it is necessary to say that they are wholly valueless; for there is no way, short of an exhaustive analysis, of knowing whether the citations are correct and the assumptions of the author in regard to them equally so.

Have we a right to ask the engineer of the period to undertake original investigations? We think not, considering their cost in time and money. Elaborate inquiries into this or that phenomena are exceedingly expensive, and, given, the man fitted for the work, we must find some other man who will supply the funds. It is not an afternoon pastime, or a week's study, to discover the real causes of the water which is found in the high-pressure cylinders of high expansion engines; yet in an hour the average observer will tell us all about it, and settle the whole thing—by speculation. We go too fast. Here is a certain device which acts upon a principle which seems to set all previously known laws aside; some of us invent new laws for the emergency; others of us say nothing but look very wise, all of us are too ready to solve the paradox on sight. No one man can carry on an elaborate investigation into mechanical or scientific phenomena. It requires one to check and to aid the other in order to arrive at anything like correctness, and such inquiries are legitimately government work. Certain sums should be appropriated every year to carry out experimental tests in mechanics; and these, if they were conducted by able men, would add very largely to the common stock of knowledge.

◆

HARD PUSHED FOR AN ARGUMENT.

PERSONS who are engaged in introducing electricity on railways are, at times, hard pushed for an argument, and use the wildest comparisons and estimates of locomotive performance to help their view of the matter. Whether it is by far too costly for railway service, or whatever the reason may be, no electrical motor has as yet shown any practical value whatever on railways, where it is possible to use locomotives. It is not for the want of experiments with electric motors, for these have been many, particularly on the elevated railways of this city. One of the most extravagant writers against locomotives is Mr. John Henry, who says this in the *Electrical Engineer*:

> "To deal with the subject properly, comparisons must be made and weaknesses pointed out. Stationary engines have automatic cut-offs; locomotives depend upon manually operated ones, which are necessarily intermittent and much less sensitive to varying conditions than a spring would be to a changing load. Poor regulation means a waste of steam. Stationary engines have balanced valves; the steam pressure against them is equalized and they consequently move freely. Locomotives, owing to their peculiar construction, require the valves to be on top of the cylinders, which precludes the use of anything but slide valves, which have the full weight of the steam pressure bearing against their movement. Owing to the compact requirements, locomotive boilers have much less heating surface than stationary boilers; this necessitates the use of a forced draught, which means that the larger portion of the heat passes out of the stack, the boiler absorbing the most intense heat only. Stationary boilers are usually covered with several courses of brick to confine the heat. This would be impracticable on a locomotive; they are usually covered with thin wood lagging, the detrimental effects from which in varying temperatures are great. I have frequently seen locomotives lose steam at the rate of about a pound per second when passing through snowdrifts The loss of fuel is very considerable in bad weather or when running against the cold winds. * * *
>
> In the absence of other accurate data on this subject, I investigated the startling economical reports of the performance of the elevated railway locomotives. I found they consumed from 50 to 90 lbs. of anthracite coal per mile, run with five coaches,

Striking the average at 70 lbs., and estimating the average weight of the trains at 250,000 lbs., to move this weight 100 miles would require an expenditure of but 276 h.p. hours; dividing this into the amount of fuel actually consumed would show a consumption of 25 lbs. of coal to the h.p. hour. This estimate is based upon a perfectly level track in good condition and no stops. The extra amount of energy lost in ascending grades is partially regained on the descent, and a certain proportion is lost by the car brakes. Some years ago Mr. Frank J. Sprague carefully investigated these losses, and, I think, placed them at about 40 per cent. of the total, which seems to be fair; this would leave the result that the New York elevated railway locomotives consumed, on the average, about 15 lbs. of coal to the h.p. developed per hour. We all know that stationary engines are on the market that will not consume over one-fifth of this amount of fuel for the same power developed.

"We all know," too, that Mr. Henry has not investigated the subject in the least, as he says he has, or he could find plenty of authentic information on the subject of locomotive performance. This would show him that the modern locomotive is a very economical machine, considering its service and the way in which it is performed. The average passenger locomotive, in good condition and running at high speed will produce a horse power for three pounds of coal, and it is not easy to beat this even with the average Corliss engine. Mr. Henry should read up a little before writing again.

AMERICAN WORKMEN'S DIETARY.

A CORRESPONDENT, who signs his letter "*An Americanized Englishman*," says that he noticed a comment in this paper recently upon the fact that an English firm had advertised for an American lathe hand, offering him $10.50 per week, as against $15 to $18, which the same man would receive here. "*An Americanized Englishman*" thinks that we have omitted to note that money has more value in England than here; that is, the same money will buy more goods. From this aspect $10.50 is better wages in England than it seems to be from our standpoint. This is true in a certain sense. This for instance: That $10.50 would buy more comforts for an English workman than the regular wages paid there; but "*An Americanized Englishman*," if he has lived long enough in this country, must have observed that there is a very marked difference in the way that Americans live and that in which Englishmen—both being workmen—live. So that, viewed from the American standpoint, $10.50 is no wages at all in England for an American. We have read consular reports, and find that the dietary of English workmen is on what we would call a very low scale here. Bacon seems to be a prominent feature of it; beer is also used in astonishing quantities. Of bread there is some mention, but, judging from what we have read in foreign papers—English papers—the main reliance is upon beer and bacon. We have no doubt but that these items are cheap enough, but we do not think that an American workman would thrive upon them as a steady diet. If he did not he would be compelled to purchase other food that he was accustomed to, such as beef and mutton, and a more generous dietary all round. When he did this he would find that his board, or the cost of living, would be as much as it is here, for the prices of beef and mutton vary but little the world over. This same is true of staples, quality for quality. Bread is cheaper nominally, but not actually, for it is not the same bread, by any means, that Americans are accustomed to use. It is made from cheaper flour, and very badly made, if we may trust what we read. Cereals form a large proportion of the dietary of an English workingman, in the morning at least. Porridge figures in alarmingly large quantities, and however palatable, nourishing, or satisfying it may be to the natives, it has never obtained popularity in American workingmen's boarding houses.

If it comes to clothing, the same comparisons hold good. A man can buy clothing as cheaply in this country as anywhere on the globe. Quality for quality, it is equal to any; foot gear likewise; excellent shoes (gaiters), good enough for anyone to wear, durable and stylish in every way, can be bought for $3.50 a pair. We know this is a fact from personal experience, for out of curiosity we bought a pair, and see no manner of difference between them and gaiters costing $10, which price we were silly enough to pay for years. In short, to sum up, there is no more value in money in England than there is in this country, quality considered.

CIVILITY IN TRADE.

A GENTLEMAN bought some machine tools of a certain firm and not receiving them when promised, wrote, requesting to know why they were not delivered. To this he received no reply. Waiting for three days longer than it would take for an answer, he telegraphed briefly: "Send tools at once, or let us know why; in great need of them." This brought a reply from the Superintendent, who fancied that this called for what he thought was a dignified rebuke. So he answered: "Tools will be sent when we are ready; not before." The customer took the next train to the works—only one hour's ride—and brought the telegram with him. He ignored the Superintendent, and went to the President with his grievance, who being a sensible man, soon arranged matters to the buyer's satisfaction. Then the President interviewed the Superintendent, and gave him some good advice on the subject of politeness in trade, which it is to be hoped he profited by.

Human nature is weak, and the best of us are liable to err; but it is a bad thing to err on the side of incivility. No matter how large or how small an order may be—five cents or fifty thousand dollars—the buyer is entitled to courteous treatment and prompt attention. The mouse gnawed the lion free of the net, and the five cent order man may know a fifty thousand dollar order man, whom he will take where he will be well treated. Civility pays every time. It is a cardinal point in business, and boors should remember that rudeness always recoils upon those who exhibit it.

PUBLIC OPINION.

A CONTEMPORARY in this city, the *Twentieth Century*, to wit, thinks that the power of public opinion was magnificently displayed by forcing General Porter, Superintendent of the Census, to back down from the position he took in attempting to compel the people of this country to tell the enumerators about their diseases and debts. This incident shows how unlikely it is that the powers of the Government will ever be increased in this country. Many persons think that they want nationalism, but when it is tried they find that they want freedom from governmental interference. The desire of the politicians is for more government, but the people at large are slowly learning how to get along with less.

Well, perhaps they are; but from our point of view they learn very slowly, and move very slowly.

Politics is a trade, or an occupation followed for the sake of the money to be made out of influence, and it is very assiduously followed in this country. It is a dirty business, which more speedily corrupts men than any other form of trading, for the reason that nothing stops men of this class who have an object in view. Once to be a politician was to be a statesman; now it is to be a huckster of votes, a giver and taker of bribes, and a small man generally. Public opinion is a mighty power when put in motion, but it is seldom exerted, and it is not always successful when it is. Public opinion is dead against the practices of coal operators and miners of coal generally, but we observe that no abatement of the evils complained of is manifest. Public opinion strongly objects to many things which are nuisances, but these last continue to exist.

A FARCE.

THE farce of examinations into this or that abuse by Congressional committees is still being played at great expense, for no benefit whatever. Recently this city has been visited by a Congressional committee, which inquired into the manner in which the excise laws are enforced. It seems that they are not enforced at all. If the official who presides over these inquiries was furnished with a squad of marines and a long rope, and empowered to hang to the nearest lamppost all persons found guilty of infractions of the law, there would no doubt be hesitation on the part of enterprising persons who desire to do business outside of the law. As matters stand at present, the Congressional inquiry only serves as a most excellent advertisement to delinquents. We cannot now recall a single abuse or nuisance which has been abated by the examinations aforesaid, and will be very much obliged to anyone who can point one out.

SPECIAL NOTICE.

The notice in our business column headed *Special Opportunity* has attracted the attention of many who do not seem to exactly comprehend the nature of the duties required. These are, briefly, to represent THE ENGINEER in business circles and among manufacturers, with a view to increasing our trade. To do this requires some business training and knowledge of business methods. It is not at all necessary that the representative should be an engineer; professional knowledge would be advantageous, but is not indispensable.

Also, some have fancied—for reasons we are at a loss to know—that the notice should be read between the lines, and that it is desired to procure a purchaser for THE ENGINEER. The notice means exactly what it says upon its face, and THE ENGINEER is not for sale to any one, or any part of it. We shall be glad to entertain overtures from practical business men who wish to place themselves eventually in possession of a good property upon very easy terms, but such possession will not inure to them until the death of the present owner of it. The whole direction of the paper and its conduct will remain as it is under all circumstances.

Read the notice again carefully.

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NOT long ago we expressed the opinion that the average passenger could be relied on to distinguish himself occasionally. Here is an instance of it:

"The peculiar performances of a passenger on the '*Iroquois*' were the cause of considerable excitement on the trip to New York. The gentleman in question behaved with great propriety until the steamer reached Charleston, when he twice attempted to jump overboard as the steamer lay at the dock. He was prevented, and afterward climbed the mast to the highest point and touched the gold ball on the masthead. He descended hand over hand down the jibstay leading to the bow. Just after crossing the bar, as the steamer was passing Mayport at the rate of thirteen miles an hour, he tied the lead line around his waist and jumped over the side for a swim. He was jerked through the water at a frightful speed, and the ship had to be stopped and the erratic gentleman hauled aboard. He said he merely wished to take an ocean dip, and thought that he could keep up with the ship."

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THE passage of the act relieving the Union Iron Works of San Francisco, from the penalty of $33,384, incurred by the cruiser '*Charleston*,' through having fallen 333.84 short of her guaranteed horse-power, shows that Congress is disposed to deal liberally with shipbuilding contractors.

Foreign and Domestic Trade Literature.

THE ADAPTATION OF STEAM MACHINERY IN MARINE CONSTRUCTION.* No.1.

By Chas. E. Emery, Ph. D.

In the preparation of plans, the naval architect and engineer must in a sense work together, and can better do so under one direction, in distributing to the various departments the space available and the proper proportion of the displacement. In this connection it will be necessary for the engineer to prepare sketches, or small-sized scale drawings of the machinery it is proposed to use as it is developed upon the basis of considerations hereinafter to be enumerated, and to furnish the weights of its various items concentrated at the centers of gravity of the several masses, so that not only the proper proportion of the displacement may be reserved to carry the total weight of the machinery, but the several details be so located that when balanced with the constructive weights of the hull and the added weights of equipment, cargo, etc., the hull will have the right draught and trim. The preparation of these preliminary plans, and of the specifications afterwards, will necessarily settle all the details of construction. The several questions will be naturally considered in the following order: 1st. The power required for a hull of given size and draught of water to produce the desired speed. 2d. The type of machinery to be employed. 3d. The general dimensions and design of the boiler required. 4th. The general dimensions and design of the engine and of its principal details. 5th. The preliminary calculation of weights, previously referred to. 6th. The preparation of the specifications for the work complete. And, 7th, the contract for the work, the superintendence of its construction, the dock and sea trials, and the transfer of the completed vessel from the contractor to the owner.

The power required to propel a given hull at a given speed depends so much upon the shape of the hull below the water line that it seems unfortunate in some cases that the engineers are not the ones to fix the lines of the hull and adapt them to the conditions. The most successful vessels are now designed by those who, though naval architects, are by education and experience engineers in the broadest sense of the term, and can therefore consider the questions of the proper shape of the vessel and various compromises which must enter into the details of construction as parts of one problem.

The object to be attained in designing the lines of a vessel is to pass from the front to the rear a column of water equal in cross area to that of the midship section of the vessel with a velocity equal to the speed of the vessel. If the vessel were cigar-shaped and submerged in a tube of double the area of its midship section, necessarily the water around it would be required to run backward at the same velocity with respect to the tube as the vessel went ahead, and with double that velocity with respect to the hull. If there were no friction, this transfer of water from the front to the rear could be made with very little loss of power, for the reason that the pressure required to produce the velocity in front would be advantageously given up to the rear of a vessel of proper shape, by reaction, as in the operation of turbines. In practice the backward current is less confined, and consequently some power is lost, even below the surface, in moving water which cannot return its energy to the hull. In addition to this, when a vessel floats on the surface some water must be thrown off in waves, from which only a small portion of the energy stored up can be imparted to the stern, and the remainder is dissipated in smaller waves of ever-increasing area in all directions.

The chief problem is therefore to reduce the formation of waves to a minimum, and to produce those that are necessary where they will do the least injury. This can best be accomplished by so forming the vessel that the water will, as far as possible, be thrown underneath or around the sides, well below the water line. It has been urged that the water should be opened with a bow containing concave or, as they are called, "hollow" lines, so that the velocity of separation will increase gradually to the middle of the forebody, where the curvature should reverse and the opening of the water thereafter be more gradual. It should be borne in mind, however, that a hollow line entrance necessarily makes the angle more obtuse, and vessel more blunt at or near the first half of the forebody, than if the entrance of the bow were less sharp, in which case the slope will be more nearly uniform and the maximum angle less.

A straight line on the bow, or even one that is convex, rather than concave, may lift more water directly at the bow, but the superior elevation of the water at that point will force it under the vessel. The hollow line vessels generally show that there is a regular shoulder under water, by the fact that a high wave is forced out near the middle of the forebody, which slopes aft on account of the speed of the ship, from which wave only a part of the energy can be returned to the hull.

A very little consideration will show that the nearer the first wave is brought to the bow, the less energy will be dissipated. It has, therefore, for a long time been the opinion of the speaker that many vessels are made too sharp at the bow on the water line, and, in the endeavor to get a straight stem, too blunt below the water line. The vessel should not, however, be cut away too much down at the keel forward, for the displacement which can be secured by carrying forward the floor is very efficient in preventing the vessel from pitching in a seaway, and does not produce injurious resistance, for the reason that at that point there is very little water to displace, as the main part of the hull is above it.

A long easy "run" or afterbody, with hollow lines near the stern, is desirable, as it permits the water which has been elevated by the motion of the ship to fall back under the stern readily and give up its energy on the inclined surfaces to assist in propelling the vessel, and, moreover, gives an ample supply of water to the screw propeller, thereby securing, as a whole, higher efficiency and greater speed. It is also thought that the beam of a sea-going vessel will be increased very greatly, compared to what it has been in the past, with a view of forcing the water under, rather than around, the sides of the hull.

This subject is not without its difficult features, as such a vessel may be too "stiff," or endeavor to right herself too quickly in a seaway, and thereby be very uncomfortable. This principle was carried to an extreme in the construction of a yacht for the Czar of Russia, which was nearly circular, and was found so uncomfortable that she was turned into a troop-ship.

Undoubtedly the highest speeds of the future will be obtained with the hulls which are swelled out below the water line, so that the water will be displaced, where it will form less waves, while the initial stability can be controlled by the distribution of the weight and a reduced area at the water line.

With small vessels, it is found that while those with hollow lines forward may do well in still water, they pitch violently at sea and lose headway by burying in the waves. The form of vessel, therefore which is somewhat full below water does not bury as much and is easier at sea; but, for reasons before expressed, the fullness should be kept well down near the keel rather than at the horizontal water lines near mid-draught. It has been demonstrated in the speaker's experience that a small yacht with rather full water lines at the surface of the water, but hollowed out below, required less power than a Herreschoff yacht of the same length when driven at the same speed, though the latter was considerably sharper on the water line and had considerably less displacement.

It can readily be seen by watching one of these horizontal wedges, as the narrow yachts may be termed, that they cause a depression amidship, which might as well be filled by additional hull as by vacancy, without perceptible increase of resistance. A compromise possessing the advantages of the two forms, for duty at sea, would seem to be a ram-shaped bow, blunt at the water line and sharper both above and below. The question is a broad one, which needs to be studied in detail with great care. Beginners should not think of attempting any new forms until they have had long experience with the old ones.

The engineer, having done all that is possible to secure a proper shape for the hull under the known conditions, is prepared to calculate the power required to propel the vessel at a given speed. It should be in general borne in mind that the resistance varies nearly as the square of the velocity, and hence that the power varies nearly as the cube of the velocity; so the simplest formula for determining the speed of the steamer is simply that the indicated horse power (i.h p.) equals the cube of the speed multiplied by the midship section and divided by a constant which varies from 300 for small blunt vessels to 600 and upward for vessels of better form and greater length.

The United States revenue cutters, which are required to do duty along the coast after storms in assisting vessels in distress, are good examples of steamers made as small as they can be, and yet be able to take care of themselves and others. They must necessarily, therefore, have the power at least of the largest tugboats, and at the same time have hulls of sufficient size to accommodate the officers and crew, and to carry sufficient coal for ordinary voyages. These vessels vary from 125 to 160 feet in length, the average size having a length of about 140 feet, and a midship section of about 133½ square feet. The constant in the formula above stated for the average vessel is about 500 to 525, as found by trial. For vessels 160 feet long, the constant rises to 600, and for those 125 feet long, which have to carry as large a crew, and nearly as much coal, and, therefore have much blunter lines, the constant drops to 450, and even 400 in some cases.

We thus see the necessity of using judgment in the selection of the constant, and many efforts have been made to devise a formula which would take into consideration the shape of the hull without exercising so much judgment. The best formula for this purpose is that of Prof. Rankin, who deduced from a large number of trials of vessels of different sizes that the principal resistance of vessels of good form at fairly high speeds is due to skin resistance, and to provide for difference in model he constructed a formula based on the skin resistance, in which the actual immersed surface of the vessel is "augmented" by introducing a function of the mean angle of entrance into the formula, so that the probable speed of the vessel with such angle is determined from the skin resistance of an imaginary vessel of sufficiently greater surface dimensions, to show that speed in a calculation based on the skin resistance. The formula was so carefully constructed that it has given the most accurate results of any other which has been proposed.

The speaker has attempted to obtain from Froude's formula of comparison the approximate speed of large vessels compared with small ones. The Froude experiments were made by pulling models through a still tank of water, measuring the strain with a dynamo-meter, and carefully noting the speed. The models were carefully shaped to the form proposed for the large vessel, and the model and vessel compared at what were called "corresponding speeds," varying as the square roots of their respective lengths, at which speeds it was assumed that the resistances varied approximately as the cubes of the lengths.

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*Delivered before Sibley College Mech. Arts.

From this we may deduce that, at the so-called corresponding speeds, the relative horse powers required would be as the three and one-half powers of the lengths. The effective power must necessarily be increased by dividing the calculated power by the co efficient of efficiency of the machinery and propeller as actually applied in the hull. On this basis, if we consider as a model a steam yacht designed by the writer, which was 118 feet long, and made a speed of 12.88 knots an hour, with an average of 250 i.h.p., the corresponding speed of a steamer $4\frac{1}{2}$ times the length, or, say, 531 feet long, would be the square root of 4.5, equals 2.12 times as great, or 27.3 knots. The yacht should be long enough to make the correction for increased unit resistance due to reduced length unnecessary, so, on the basis that the power varies as the 7.2 power of the length, the large vessel, at a speed of 27.3 knots, should require 48,326 i.h.p. This speed is too high for comparison with ocean steamers now in operation, but the probable results for a reduced speed may be made on the customary basis that the i.h.p. is proportioned to the cube of the speed. This comparison gives 21,996 i.h.p. for a speed of 21 knots, which is known to be somewhat larger than the power actually required by steamers of this length at that speed. This may be accounted for from the fact that the yacht was not as good a model as that of the larger vessel, and, therefore, showed a higher resistance; but, since both are fair models, this should not make a great difference. If, however, we consider that the effective horse-power of the large vessel was 62 per cent. of the i.h.p., and for the smaller one only 53 per cent., the power for the larger vessel would be reduced to 18,854 i.h.p, which is about right.

This result shows that possibly Froude's method of comparison may be advantageously employed in ascertaining the speed of steamers of unusual size, by using other vessels of known performance as models. The Froude formulæ, however, need careful revision, as some of the preliminary assumptions were modified by the experimental results, and the accuracy of the results is simply due to the balancing of errors.

All the formulæ adopted for this purpose under consideration are necessarily largely empirical and are not applicable through a very wide range. Even Rankin's formula gives speeds too low for our very large ocean steamers, which now cross the ocean at such remarkable speeds. Ordinarily it is about as well to use a formula containing a constant based on the results obtained with a steamer approximately of the same size, thereby utilizing the latest developments.

The applicability of the simple formula i.h.p. equals speed cube multiplied by the midship section, and divided by a constant, is shown by the fact that it will give for an ocean steamer about 500 feet long, with a midship section of say 1,200 square feet, using as a constant 600, a speed of 21 knots with 18,522 h.p., and will give for a revenue cutter of $133\frac{1}{3}$ square feet midship section, using same constant, a speed of 11 knots with 296 h. p.—results in both cases substantially correct.

There is an interesting relation between the speeds of similar vessels of different size which are actually obtained in practice. The whole question in relation to steam yachts was very actively discussed several years ago in connection with the development of a time allowance for the regattas of the American Yacht Club. One gentleman, with great care, obtained the recorded speeds of yachts of different lengths on the water line and made up a table based thereon, suggesting that a yacht of a given length should make those speeds, but no rule was given by which the speeds for any other lengths than those stated could be computed. Others proposed time allowances in which it was attempted in various ways to consider the actual powers employed as well as the size of the vessel, so as to require the vessels containing the greatest power to make more speed in order to compare with others. The writer considered that as every vessel was a compromise, the fastest yacht of a given length, which provided suitable accommodations in addition to the required space and displacement for the machinery, was the better one; that is, that the owner had made the best use he could of the general dimensions he had selected, and that yachts of different sizes should only be handicapped by the increased dimensions the owner had selected. He, therefore, decided to adopt in a formula such function of the length of a yacht as would give fairly the speed customarily made by a first-class yacht of that length, and from that compare the relative performances of other yachts of the same length, when the formula would make due allowance for the differences in length. This plan was received with favor, and several prizes termed "Emery Cups" have been awarded under what was termed the time allowance of the speaker, based on the rule that "the speed of the yacht in knots per hour should equal 2.7 times the cube root of the length of the hull on the water line."

Tables were prepared, of which an abstract is presented, giving the speeds of yachts of different lengths and the time required to run over the official course of 80 knots at such speeds, and the latter made the basis of the time allowance. For instance, a vessel which by rule should run 10 knots per hour was allowed eight hours, and one which by rule should run 16 knots an hour was allowed five hours, and the relative standings of vessels of all lengths were shown by the number of minutes each fell short or exceeded the time allowance due to its particular length. The rule proved to be remarkably well adapted for the vessels of the squadron. During the second regatta, the large yacht '*Atalanta*,' 229 feet long, belonging to Mr. Jay Gould, ran over the course within three minutes nine seconds of her time allowance on this basis; the '*Radha*,' 135 feet long, within three seconds; the '*Rival*,' 88 feet long, within three minutes fourteen seconds; other yachts within ten to twelve minutes, and no vessel was an hour behind its time allowance. Similar results were obtained at other regattas. This gratifying result does not show any theoretical relation between speed and length. It simply means that in ordinary practice the compromises of weight are so made that the rule expresses very closely the speeds that may be expected. When more power is applied and everything else sacrificed, higher speeds are obtained. It will be observed, also, that the rate of increase for length is less than that for comparison by Froude's formula, which shows simply that in yachts it is not ordinarily convenient to increase the horse-power as the 7.2 power of the length. and, in fact, not quite as rapidly as the increase in cubic capacity, the increase in horse-power being nearer the 7.3 power than the cube of the length.

Having determined the probable power required by means of the above simple formula based on the midship section, checked by Rankin's formula, and any other that may be convenient, using, however, for comparison in all cases, vessels as nearly the size proposed as possible, we next proceed to settle the type of machinery which is to be selected for producing the power in a hull of the size and form fixed by the other considerations hereinbefore referred to.

(*To be continued.*)

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THE Mason Regulator Co., 10 Central Street, Boston, Mass., will send you a handy little device for carrying postage stamps in your pocket if you send them a penny stamp.

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"I HAVE long observed," says Captain Butlin, "that there is some three miles an hour difference between sixteen measured miles and "about sixteen miles an hour."

PETROLEUM IN STEAM BOILERS.[*]

By R. C. CARPENTER.

The paper on this subject by L. F. Lyne induced me to give the oil a trial in the boilers of the steam-heating plant of our State Agricultural College at Lansing, Mich.

The boilers experimented on are of the ordinary tubular type, each being twelve feet in height, four are four feet in diameter each, and the remaining two five feet in diameter.

The use of the oil was commenced in April 1889, with the boilers very badly incrusted with a hard scale. Previous to this time the only method used to remove the scale had been by employing a workman to go inside the boiler and knock off what could be reached with a hammer and scaling iron The estimated cost of this method of cleaning was $18 to $25 per annum for each boiler, and the results were very unsatisfactory, as more than two-thirds of the heating surface was entirely inaccessible. The scale was fully three-eighths of an inch thick in many places

The first application of the oil was made while the boilers were being but little used, in the warm season, by inserting a gallon of oil, filling with water, heating to the boiling point, and allowing the water to stand in the boiler two or three weeks before removal. By this method fully one-half the scale was removed during the warm season, and before the boilers were needed for heavy firing. We found, however, that a more effectual way was to supply the oil in small quantities when the boiler was in actual use. There is no question regarding the action of kerosene oil in softening the particular scale deposited from the water which we use and it also seems to work in between the scale and the boiler plate in such a manner as to loosen large flakes of the scale, sometimes fully a foot in length. On opening the boiler they are found deposited on the bottom, and readily removed by rakes; the great mass of the scale, however, is removed as a fine mud through the blow-off pipe.

In regard to the quantity to be used, we found that beyond a certain amount no benefit seemed to result; for boilers 4 feet in diameter and 12 feet long we obtained the best results by the use of 2 quarts, or one-half gallon, for each boiler per week, and for each boiler 5 feet in diameter 3 quarts per week.

The oil was readily fed by adding a one-fourth inch branch to the suction pipe of the feed pump, and leading it to a vessel containing kerosene oil. By this method a quantity as large or small as desired could be introduced into the boiler at the same time with the usual feed, and in the form of an emulsion of water and oil.

At the present writing our boilers have less scale in them than at any previous time during the past four years, and the small amount in them seems to be soft and gradually disappearing. A large portion of each boiler shows the clean black steel, apparently in as good condition as when new.

I do not believe that the oil will produce any injurious effect on the iron: in fact, I cannot see why it is not the best possible preservative for it

Our boilers are some distance from the various buildings heated, and steam is transported through underground pipes: the extreme distance being about 800 feet in opposite directions. Despite the small quantity of kerosene used in the boilers, the odor was perceptible by opening an air valve to any steam radiator in any of the buildings.

When as much as a gallon per week per boiler was used the odor was very strong, but with one-half that amount it was hardly perceptible, and only to be noticed when an air valve had been open a long time.

Since commencing to use the oil, a much greater deposit of rust scales than usual has been found in the various steam traps in the buildings, indicating, in my opinion, that the oil is also exerting a cleansing influence on the pipes of our whole system.

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[*] Presented at the Cincinnati meeting of the Mechanical Engineers.

The expense of this oil is very light, as compared with any other preparation for cleansing boilers known to the writer. The expense to the college per boiler has not exceeded $2 per annum for the kerosene used.

POINTS FOR AMERICAN MANUFACTURERS.

AMERICAN manufacturers have been in the habit of forwarding to Colombia, States of America, such goods as they thought the Colombians would buy, and have been surprised to find they made no sales. Many of these goods were absolutely dead stock for the simple reason that the people had not an idea of how to use them or could not apply them. What is the use, for example, of shipping a McCormick reaper to farmers that grow no wheat? Some of the goods sent out could not be sold because, in a country of canoes and pack-mules, they could not be carried.

For instance, the standard American white cotton is woven twenty-seven inches wide. This cannot be sold in Colombia, because with pack-mules the *carga*, or pack, must not be more than twenty-two inches long, as otherwise it will gall the hips and shoulders of the animals. American cotton can be roped on a pack-mule, with the bolts lashed vertically, but such a pack is very apt to get disarranged, and the *cargero*, or muleteer, charges more for the trouble he is put to. Naturally the merchants in the interior of the country purchase English or German cotton, woven to forty-four and folding to twenty-two inches. Again, the Americans have shipped—and may still ship—colored prints to Colombia. These have been very bright and pretty, and have been such as have sold well in this country. They have not sold there except among a few of the ladies who have seen them. Why? Simply because the majority of Colombian ladies wear nothing but black and white, and the peon women do not want the new patterns. If there is any person on earth who is conservative, it is the peon woman. In colored prints she wants the same pattern and the same material her mother and her grandmother wore before her, and which her daughter will wear after her. These patterns are not pretty, being chiefly purples with white spots, but, such as they are, they have been worn by the lower-class women in Colombia for centuries. Why should an American manufacturer try to overcome such a prejudice—if you like—as this? The Germans and English are wiser in their generation. They make the prints the peon women want, and they color them with the ugly purples these women admire, and they make them of a width that will pack easily on a mule, and of a weight that gives eight pieces as a mule's load. And then they sell them, and the trade grows to such a point that we are compelled to pay our Colombian bills for rare woods with exchange on England.

Mr. E. P. Pellet, of Barranquilla, Colombia, one time United States consul in that city, was so much struck with the absurdity of American shipments of prints that he procured samples of all sold in Colombia. With these he prepared a table, giving weight, width and length, and the number of pieces of each imported through the Barranquilla and Carthagena custom houses for one year. He mailed the whole package to the president of the Boston Chamber of Commerce, advising him by letter of his action, and saying he supposed the information would be of sufficient value to the Chamber to make it worth their paying the postage. This amounted to $2.37. The president of the Chamber of Commerce that year did not consider the package worth $2.37, and it was returned to Mr. Pellet, who thereupon paid the postage both ways. They are poor cottons, full of clay and not well woven, but they will sell in Colombia better than the handsomest prints made here.

We believe, and with reason, that with our great wheat fields, our enormous mills, and our labor-saving machinery, we are in a position to command our fair share of the trade in breadstuffs. We sell flour to England, and she makes "biscuits," called by us "crackers," and sells them to Colombia. There is no reason why we should not have this trade, if our manufacturers would consider the necessities of the market. I saw in the little town of Zaragoza some *cargeros* packing a box of American crackers on a mule. As far as Zaragoza the box had come by steamer and steamboat, but from this point to Remedios it was to travel on a pack-mule. The box was four feet long, two feet wide, and twenty inches thick. The *cargeros* procured a long gang-saw and cut the box, crackers and all, exactly in halves. Over the open ends thus made they tied raw hides, to protect the contents, and then lashed the two halves in place with the pack rope. Alongside of this American box was one from England. It measured 22 by 22 by 20 inches, the wooden sides, top, bottom, and ends were more closely joined, and it was just the right size to pack easily. Which box would bring its contents in better condition to Remedios after a six days' trip through woods dripping with moisture from the heavy, nightly, tropical rains—the English or the American? What were the chances for those American crackers after they had traveled for six days under filthy raw hide covers? Who would get the next order for crackers—the English or the American merchant?—*The Century.*

LIGHTNING RODS.

THOSE who understand the power of the electric current are least favorably impressed with the methods of drawing off that current from the atmosphere during an electric discharge. Both the size and composition of the rods are inadequate for carrying off so heavy a discharge. Iron is one of the poorest conductors, compared with copper or zinc.

A copper rod, to be efficient, should be at least three-fourths of an inch in diameter. An iron rod of equal efficiency should be eight times the size of the copper rod, as copper has eight times the conductive capacity of iron. If parties employ iron rods, then galvanized iron is better than the common by reason of the coating, which protects it from rust.

As to insulation, any known insulator, be it glass or wood, or any of the common forms of insulation, are inadequate during a heavy discharge from the clouds. To indicate the enormous electromotive force of the ordinary electric storm, it might be well to compare the artificial lightning produced by human beings. The ordinary induction coil, with a voltage beyond measurement at the present stage of the art, only creates a spark varying in length from one-half inch to three inches. Such a spark is difficult to insulate, as it will pierce glass to the thickness of one-eighth of an inch, and wood or paper two or three times as thick. Now, compare such a diminutive spark with a discharge of lightning which has been known to reach one mile in length. If the spark of the induction coil, measuring two or three inches in length, pierces glass or wood as above, what must be the insulation required to control a spark half a mile to one mile in length, with all the batteries of the sky, and with an electromotive force millions of times beyond the computation of man?

It is apparent that the usual insulators used on buildings must be entirely made-quate for such a purpose. In many electric storms, where the discharge follows the wire, it divides in many instances, part of the discharge following the wire, and part, regardless of any insulator commonly used, entering the house at one or more points. For all practical purposes, the building is in a worse position than if its owner had not attempted to protect it.

In the ordinary electric storm a house would usually fare better without the protection of the lightning rods, because the electric clouds in their discharge would naturally strike a tree, high rock, or some other elevated object in proximity to the house, and would not be attracted to the house by the iron or copper rod. In other words, if the lightning rod will do what is claimed by the manufacturer, it becomes at once a dangerous fixture, simply because if it does attract the electricity it affords no adequate means of taking care of it. And it would be far better to let the cloud discharge at some other point than the house, rather than to take the risk of its discharge down the conductor, with almost a certainty of its dividing and entering the house. Lightning always takes the shortest conductor to the earth, and tall trees in the vicinity of a house are an efficient safeguard. It has been suggested by experts in electricity that a very efficient safeguard would be to run a large iron or copper conductor into a tree, and then if the lightning was attracted to the tree or the conductor, and it divided up in the passage to the earth, no damage would be done to near-by buildings.

One thing may be safely said, that if a discharge of lightning from a cloud is pointed directly toward a house, there is no human means of diverting it from its course, or preventing its passage in the direction which it has taken, and all the feather beds and lightning conductors that might be provided would scarcely protect a person who stood in the way of the current. It is a well-known fact among observers that the presence of lightning rods upon houses has often failed of providing the expected protection, and there are millions of houses unprotected by lightning rods that have never been struck by lightning.

If one stops to consider the enormous current to be dealt with and the tremendous electromotive force of such a current, it is plain to be seen that no human method can be devised for safely taking such a current out of harm's way, and the man who sits in his house during a thunder storm, protected by iron lightning rods the size of his little finger, and insulated with little pieces of glass, which are no more protection than tissue paper, has not the safety which the lightning rod man promised.

Telegraph wires are insulated by glass fully an inch in non-conducting surface, with glass sides fully one-quarter of an inch in thickness. And yet all this precaution in insulation is taken with a current not exceeding 400 volts of electromotive force. Leakage is a troublesome factor even then. What shall we say when the lightning rod man places similar glass insulators on your house to protect your little iron rods from discharging into your buildings the lightning of the heavens, whose electromotive force cannot be measured even by billions of volts. It is like comparing the pop-gun with the thousand-pound Columbiad.

There is no special attraction in an ordinary dwelling house why the discharge should select that medium for reaching the ground. Trees, rocks, moist earth, soil with minerals, are equal, if not better, conductors than ordinary houses and barns. If the electricity in a storm cloud has reached sufficient tension to overcome the resistance offered to its passage to the earth, it will discharge at that point and at that time, and no human effort or contrivance can change its course.—*Manufacturers' Gazette.*

◆

AT a recent drill of cadets at West Point, after the squads of skirmishers had advanced, fired and retreated, the field pieces thundered a volley, and when the smoke had cleared away not a vestige of the battalion was to be seen, save an occasional wheel or sponge. Every one of the 300-pound guns had been dismounted, and the gun crews had disappeared with the pieces thereof in the short space of six seconds. This was something new to the board, and the gentlemen made a note of it.

This was probably the flying artillery squad!

MONEY IN HONEY.

"I have thoroughly convassed every large city in Europe and America in selling honey, and it is true that more honey is bought for table use in and near New York City than in any other spot in the world. There are in New York and Brooklyn eight concerns which deal exclusively in honey, and keep twenty-six wagons carrying on business with the retail grocers. In this way about a ton of honey a day is sold, or considerably over 312 tons a year. This, of course, does not include the large quantity distributed to outside towns by wholesale dealers. However, while local consumption of honey is greater in New York and vicinity than anywhere else on earth, the largest general distribution is from California. We shipped from Southern California last year, mostly to Eastern States, 900,000 pounds of extracted honey, while 1,000,000 pounds were sent out in 1888, 950,000 pounds in 1887, 2,000,000 pounds in 1886, and 1,270,000 pounds in 1885. To Europe from San Francisco last year 1,745 cases of extracted honey were sent In the past seven years an average of 7,500 cases per year were sent by sailing vessels to foreign ports, mostly to England. We send honey to Australia, the Sandwich Islands, British Columbia, and even to India. This foreign demand was aroused by the 100 tons of American honey which I took to England in 1877.

"It was collected on the bee farm of J. S. Harbison, California, and was probably the largest crop of honey ever gathered from one apiary. At that time English people had no faith in American honey, and I placed a large lot on exhibition in the Kilburn show. One day, when the Prince and Princess of Wales came to visit the show with their children, they spent considerable time examining the American honey department, and asked me no end of questions about the extent of the industry, and the methods of carrying it on. The Princess was especially interested. I was green from the States at that time, and to the questions of the Princess I replied 'Yes ma'am,' and 'No ma'am,' and so on. Next morning I awoke to find myself famous, for George Augustus Sala had written an editorial in the London *Daily Telegraph*, in which I learned that I ought to have said 'Your Royal Highness' instead of 'ma'am.' It seems my unconventional American way of talking rather interested them, for I was rewarded by receiving an order for a lot of honey to be sent to the Prince at Sandringham, and also another to be sent to the Queen at Windsor Castle. After that, American honey was in great demand.

"To most persons honey is honey, and nothing else," continued Mr. Hoge, "but there is a great diversity in the flavor and color, caused by the different plants from which it is gathered. It varies as the flowers vary in the various districts where the honey is gathered, and by a little practice a blindfolded man can distinguish the different flavors, as a wine taster can describe the different flavors in wines. Bee culture has so far progressed of late that bee-keepers, by a little intelligent management, can keep the various flavors of honey separate. To those who persist in the habit of eating honey and hot biscuits for supper, a slow educational process has been of advantage in learning the different flavors of honey, and there has come to be a scale of value in the market according to the flavor. The favorite flavors are white clover, basswood, white sage, Spanish needle, golden rod, eucalyptus, and orange blossom. The medicinal principle of plants, futhermore, is contained in the honey in greater purity than the pharmacists have yet discovered. A teaspoonful of honey gathered from smartweed causes profuse perspiration. You remember that Xenophon noticed that soldiers of the Ten Thousand, on their march through Colchis, who ate honey gathered from the poppy flower, 'lost their senses.' They fell asleep through opium eating—that was all. Honey gathered from blossoms of the fig tree is a laxative, while honey from the horehound flower is with many a specific for coughs and sore throats. It has been discovered also that bee stings made into a lotion are a specific for rheumatism, gout, and lumbago. I have made some liniment myself by pulling out the bee stings. The operation is naturally a delicate one. I take up the bee—alive of course—with a pair of jeweler's tweezers, and by squeezing it the bee thrusts out the sting. This is grasped with another pair of tweezers and the sting and little poison sack pulled out. I have made, as I believe, several cures of rheumatism by the aid of the lotion.

"It is a curious fact," continued Mr. Hoge, "that a bee will return time after time to the same flower, although its hive may be a mile or more distant. How did I discover it? By sitting down beside a flower blossom, and when a bee alighted sprinkling a little flour on him. While sitting and watching for the bee to return another strange thing I observed. The nectar from which the bee distils his honey gathers slowly on the petals of the flower and forms a very tiny drop at the bottom of the cup. If a bee happens to alight at that instant on the blossom he sucks the nectar into her honey sack and flies off to the hive with it, but if the bee does not come just at that minute then the drop of nectar is evaporated by the sun and wind. Perhaps this happens a score of times in a bee district before a bee visits a blossom. Taking into consideration all the flowers that bloom in this big country, and the nectar that is evaporated only to perfume the air, there is as much wealth lost every summer from failure to gather the honey as there is gold dug out of the mines in California. I can remember the time when in Southern California the natural luxuriance of plants was not checked by grazing of cattle, and from Washington Territory to Lower California and from the Sierras to the Pacific Ocean was one vast bee garden. Yet at that time there was not a bee hive in the State. Now it is the chief honey producing State in the Union."—*N. Y. Sun.*

◆

ZINC is troublesome to cast, and more troublesome when small, thin molds are to be cast. Lining the mold with whiting and water, which must be allowed to thoroughly dry, will often cause the metal to fill the mold well. Burning of the zinc (oxidizing) may be prevented by covering the metal while in crucible or ladle with a layer of common salt, a little muriatic acid, which amounts to the same, as a coat of zinc oxide is immediately formed on the surface of the melted metal, which effectually prevents further oxidation from action of oxygen in the atmosphere. It is an improvement to keep a layer of charcoal on top of the zinc, or any other soft metal which can be melted in a ladle. The coating of oxide forms a protection against oxidization to only a certain degree, while the layer of charcoal tends to reduce the oxide again to its metallic form. Indeed, it is possible to recover lead, tin, zinc, and antimony, from the "dross" or oxide which gathers in the ladle. It is only necessary to melt the oxide with charcoal, salt and soda to get it again into useful shape. The dross should be powdered, likewise the salt, charcoal, and soda. Mix them together and melt. The soda and salt melt into a pasty mass, and the carbon unites with the oxygen of the dross, leaving the metal free, but burning off the charcoal. The salt and soda act simply as flux in reducing the oxides.—*The Northwestern Mechanic.*

◆

GLASS tubes can easily be bent by heating them in a spirit lamp flame, revolving the tube gradually, and moving it endwise so that some area is exposed to heating. The upper part of the flame is the hottest, and when the glass is seen to be hot enough slight pressure with the fingers will give almost any radius.

THE enterprise of California mining men seems unlimited, and overcame all obstacles. The machinery now in use in the different branches of mining is unexcelled, and every idea suggested by experience has been worked out in a practical form, which has established a reputation for the State that is appreciated the world over. In quartz mills the reduction of ores has been brought down to a science, and the gravel miner thinks nothing of turning a river miles out of its course or working its bed with wing dams, whichever seems most feasible at the moment. Water has often to be brought in from great distances, requiring at times great engineering skill to overcome topograpical difficulties. Great storage reservoirs have been built in the Sierras, commensurate with the magnitude of the hydraulicking operations. The reservoirs built in the Yuba, Bear, Feather and American Rivers have an aggregate storage capacity of about 50,000,000 gallons. There are in all about thirty main ditches in Placer, Nevada, Butte, and El Dorado counties, the cost of construction ranging from $500,000, to $1,000,000.

In conveying the water many original devices have been employed. None more so than the bracket flume, which has been constructed in Butte County along the face of precipitous cliffs to avoid the erection of lofty and expensive trestlework. In this case the line of ditch was run some two hundred yards up the canon, abutting against a perpendicular wall of bassaltic rock, along the face of which, 118 feet above the bed of the ravine and 232 feet below the top of the cliff, the flume was carried in brackets for a distance of 486 feet. The brackets are made of T rails bent into the form of an L. The brackets are 8 feet apart, and were tested to sustain a weight of 14½ tons. The flume is 4 feet wide and 3 feet deep (inside measurement), and has a capacity of 3,000 inches.

◆

THE question as to who was the inventor of the pencil eraser is one that has caused considerable interest from time to time, and it is only lately that some one in France, who was poring over the history of the Academy of Sciences in Paris for the year 1752, came upon the following passage, which explains the matter: "Those who make use of pencils from lead mines to draw architecture, fortifications, and so forth, use the crumb of bread to rub out the marks of the pencil. M. Magalhaens, or, as we spell it, Magallan, member of the Academy, a worthy descendant of the great navigator who discovered the strait south of Patagonia, which now has his name, proposed a more effectual and convenient eraser in the shape of a piece of rubber, which can always be carried about. Rubbing by this new method is found to more satisfactorily remove the marks of the pencil and all other spots that are on the paper."

The above is from the New York *Times*, but it seems to leave the matter open. Erasive rubber, so-called, is a compound of rubber and pumice stone, and the inventor of this is not known to fame. It does not seem to be a very important matter, anyway.

◆

"ITALIAN bees were the first brought to the United States by Park Superintendent Samuel B. Parsons, then a horticulturist and bee-keeper in Flushing in 1850. There are now several dealers who receive regular invoices of Italian queen bees in summer direct from Italy. An Italian queen bee is sold from $4 to $10. The best queens are as yellow as gold from head to tail. Italian bees have longer tongues than black bees, and are enabled to gather honey from flowers which cannot be fathomed by the black working bees. Another thing, they are almost proof against moth, the pest of honey bees; and, furthermore, they are very prolific. It seems as if $10 is a high price for one bee, but it is worth the price."

TRADE NOTES.

JOSEPH CRAGG, a well-known Baltimore marine engineer, died June 1, aged seventy-six years.

⁂

THE perfection of ventilation is now attained by electricity. The new United States man-of-war '*Baltimore*' is supplied with an electrical ventilator which will change the atmosphere of the engine room completely in two minutes.

⁂

DRUNKARDS are to be prohibited from riding in public conveyances in New York. It seems that there are no places in this world where drunkards are wanted, and yet there are thousands of young men in training for drunkards.—*New Orleans Picayune.*

⁂

THE American Society of Mechanical Engineers, at its convention in Cincinnati, appointed a committee to report a standard method of testing locomotives, to include the engine, the boiler, the quality of the steam and the comparative efficiency of simple and compound locomotives.

⁂

THE sailors' and firemen's unions in this city and vicinity have been asked to send delegates to a World's Congress of all marine trades, that is to be held in Glasgow, Scotland, the first week in September. The congress will appoint an executive, with general power over the marine unions throughout the world.

⁂

DAVID B. JACKSON, chief engineer of the steamboat '*James W. Baldwin*,' running between New York and Rondout, was found dead in his berth, June 4. He was 72 years old, and had been in the employ of the Romer Company for forty years, and chief engineer of the '*Baldwin*' since she was launched, thirty years ago.

⁂

THE steel steam yacht '*Almy*,' building for Frederic Gallatin, of this city, was launched at the Harlan & Hollingsworth Company's shipyard at Wilmington, Del., June 5. The yacht is 176 feet long, 24 feet beam, 13 feet deep, has triple-expansion surface-condensing engines, and is divided into six watertight compartments.

⁂

THE '*H. M. Whitney*' has just been built by the Cramps of Philadelphia, and is intended for service in the Metropolitan Line between New York and Boston. She is 288 feet long, 43 feet beam, and has a gross tonnage of 2,706. She has triple-expansion engines, with three cylinders of 29, 45 and 74 inches, and four steel boilers, with a steam pressure of 160 pounds to the square inch. She was designed by Herman Winter, Supt. Engineer for the company.

⁂

THE Admiralty Court awarded £7,500 to the British steamer '*Aldersgate*,' and £600 to the American steamer '*Ohio*,' for the services they rendered to the Inman Line steamer '*City of Paris*' in towing her to Queenstown after the breaking down of her machinery. Mr. Justice Bull says, in his decision, that if the weather had been bad after the accident occurred, the '*City of Paris*' would doubtless either have founded or drifted ashore. He praised the conduct of everybody on board the '*City of Paris*.'

⁂

THE efficiency of the street car motor is unquestionably not yet high enough for the motor to compete with the locomotive in railroad service. The cumbersome gearing now in use is a serious obstacle. There seems little doubt, however, that it will presently be dispensed with, and an economical motor will be applied directly to the axle. When this is done the commercial efficiency of the electric locomotive will be equal to that of the steam locomotive, and electricity will be adopted for ordinary railroad service.

⁂

BURGESS has finished the lines of a steam yacht for John M. Forbes, to be used in southern cruising. The new vessel will be built of steel and will be 140 feet long on the water line, 25 feet 6 inches beam, and 8 feet draught. She will be an auxiliary cruiser, with light-powered machinery, a double boiler, and sufficient sail speed, in the form of a two masted schooner, to drive her at good speed under sail alone. For the bettering of her performance by the wind, the new vessel will be fitted with a centerboard, to fit below the cabin floor, 24 feet long and dropping 7 feet. A feathering propeller will also be used.

⁂

THE State Factory Inspector is charged with the duty of seeing that the weekly payment law is enforced. He proposes to know what the corporations, manufacturing or municipal, intend to do when the law becomes operative, on July 1, 1890. To this end he has prepared two blank forms, which are to be printed and sent to every manufacturing corporation in every city, and every incorporated village in the State. These blanks the President or Superintendent or other officer of a manufacturing corporation, and the Mayor and President of city or village are requested to fill in with information as to the number of persons (male or female) employed by the corporation they represent; the mode of paying each person his or her salary or wages; whether they propose to change their system to that prescribed by law after July 1, 1890, and, if so, how much they propose to keep back of their employees' wages each week.

Rochester and Buffalo have received opinions from their respective Corporation Counsels to the effect that the law includes all the employees of the City Government. New York's legal adviser is of the opinion that day laborers are alone affected, while the Factory Inspector deems the terms wage and salary as used in the law, synonymous, and will take issue with any corporation, municipal or otherwise, which declines to pay all its employees once a week.

⁂

MR. S. N. HARTWELL, C. E., says, in describing a tubular boiler 12 feet long, 54-inch shell, containing seventy-three 3½-inch tubes: "The furnace gases, owing to their levity, find their way through about one-half of the upper half of the bank of tubes, and, so far as mere thoroughfares for the gases, one-half or five-eighths of the number would be ample, while, as a matter of heating surface, the balance are not worth their cost. This has been demonstrated by experiments made by the United States Government in plugging successive rows of tubes, making an actual gain in economy of evaporation. By the writer, a still greater gain has been realized by fitting thimbles to the exit ends of a number of banks of tubes."

⁂

POSTMASTER-General Wanamaker is anxious to increase the efficiency of the free delivery service, and to this end desires to secure a device for a letter box, of simple construction, cheap, and that can be fastened to doors without injuring or defacing them. He has appointed Postmaster Van Cott, of this city; Postmaster Hanlon, of St. Louis; Postmaster Ross, of Washington; Postmaster Nott, of New Orleans, and Postmaster Corse, of Boston, a committee to report as to the box best suited for the purpose. He will then, probably, recommend the box selected by the committee to the public for general use. Manufacturers and inventors will have until Oct. 1 to send in their models to the committee. They may be sent to any member of the committee. The public are also invited to send suggestions.

⁂

THE Barnard Separator, 15 Cortlandt Street, has special value when attached to the exhaust pipe of an engine using a surface condenser. By an improved device, the separator is continuously and effectually drained. No water, oil or dirt from the exhaust steam can pass into the condenser. This feature is of great value to all engines, marine or stationary, having a surface condenser, as it insures maximum efficiency and greater durability of the condenser, on account of the cleanly condition of the steam and consequent absence of deposit on the tubes of the condenser. By removing the oil and dirt from the steam before its condensation, the condensed water is available for feed, as it is practically pure distilled water of the very best character for use in boilers afloat or ashore.

⁂

As an instance of the speed at which the world is advancing, the *Electrical World* calls attention to a prophecy which a writer in *Harper's Magazine* hazarded in the year 1856. This infatuated dreamer predicted that in the year 3000 men would be able to attach an ear tube to a wire and hear conversations two miles away. In the course of a dozen centuries, he dared to believe, news would be printed by electrical agency on rolls of paper for prompt and convenient distribution, and that fac-simile transmission by wire would become an accomplished fact. "It is not easy to realize," says the *Electrical World*, "that since the *Harper's* ingenious contributor thus gave reign to his imagination there have elapsed not the twelve centuries he expected, but merely a matter of less than two score years."

⁂

"COMMODORE Starbuck is very well pleased with the two 500 h.p. Roberts water tube boilers in his iron steam yacht '*Tillie*,' and says that he has at last found something to suit him, as they have increased his speed, decreased his draught and coal consumption, and give him all the steam he wants with natural draught, whereas formerly he had to use his blower. The yacht '*Radha*' has four of these boilers in her, giving collectively about 1,000 h.p. This is said to be the first attempt made to run water tube boilers in a battery of four, and they give excellent satisfaction. The '*Radha*' made a trip around Long Island last week on about five tons of coal, and her time from Fire Island inlet to the Hook Dock was just two hours and thirty minutes; the distance being thirty-eight sea knots. She will run nearly as fast with three of the boilers as with four, and has no use for a blower.

⁂

THE third meeting of the American Boiler Manufacturers' Association will convene in this city Tuesday, July 1. The question which will no doubt attract most attention is that of forming a boiler manufacturers' insurance company, as was proposed last year. The committee appointed to consider the subject is a large one, having for its chairman Mr. R. Hammond, Lake Erie Boiler Works, Buffalo, and Philip Rohan, of St. Louis. Every member of the committee is in favor of establishing the company, and intend to formulate a scheme for adoption by the association. The Committee on Materials and Tests will report the proportional thickness of iron and steel to the diameter of the boilers, also the Committee on Manholes and Manheads, and the Committee on Safety Valves and Horse-Power. The Committee on Uniformity in State Inspection Laws will submit a form for a law governing the inspection of boilers, the adoption of which will be urged upon the different states.

⁂

A BILL has passed the House giving authority to the Director of the Mint, with the approval of the Secretary of the Treasury, to change the patterns and styles of the United States coins. As soon as the bill passes the Senate, which it is thought will be in a very short time, Director Leech will advertise for designs, and the contest will be thrown open to all amateurs and professionals, with awards of $500 for each design accepted. Up to the present time the law has not permitted any alterations in the coins of the nation, save by special act of Congress in each case. But the passage of the bill referred to will give the Director of the Mint, with the Secretary's approval, power to make changes according to his discretion once in twenty-five years. When the time comes, competitors should send in their designs, if possible, in the shape of models of plaster or papier mache, or any convenient substance, and not merely drawings. Here is a great opportunity for some ingenious person to earn fame and a pretty sum of money by turning out one or two acceptable suggestions.

◆

THE big steamship '*City of Rome*' has been butting the Fastnet Rock, after which the passengers fell down and worshipped her commander for the prompt manner in which he got them out of the difficulty. In this case the commander got them into it, and the engineer got them out of it. Congratulatory services should have been held in the engine room by the passengers, instead of in the saloon.—*Marine Journal.*

◆

WE are desirous of obtaining several serial articles for the coming fall and winter, and will thank all who have practical matter of this class to submit their copy. Essays are not wanted.

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IN former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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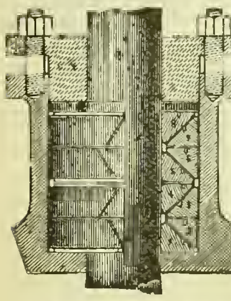

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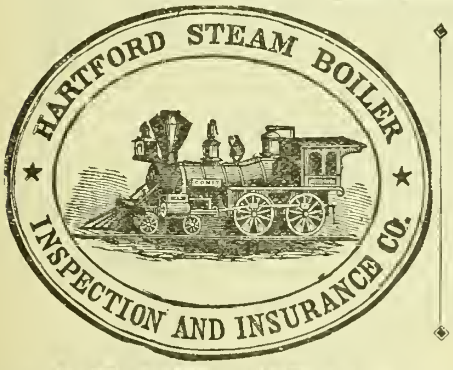

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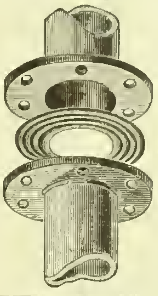

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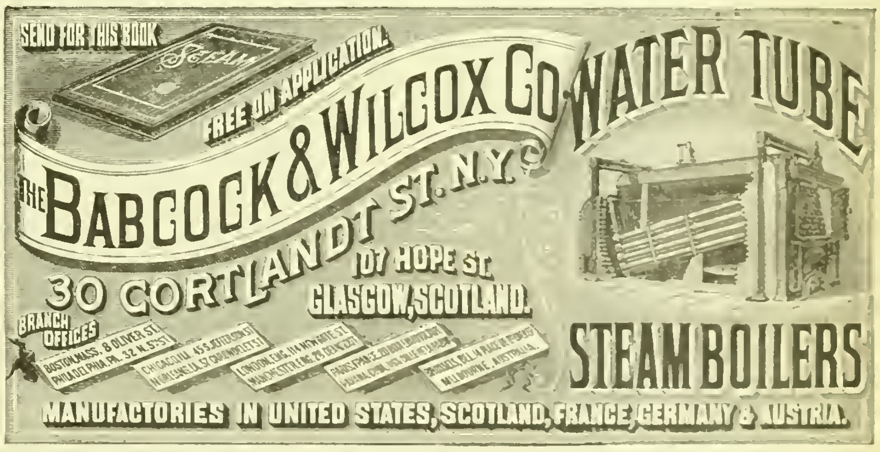

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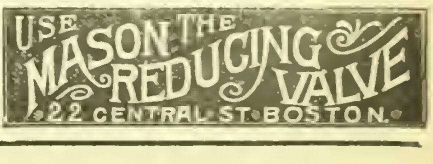

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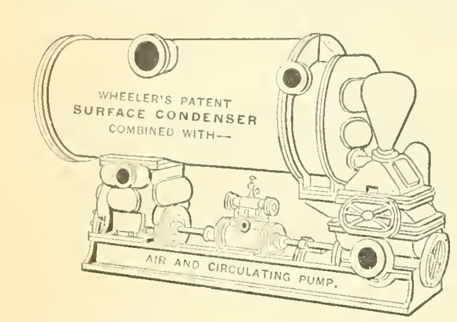

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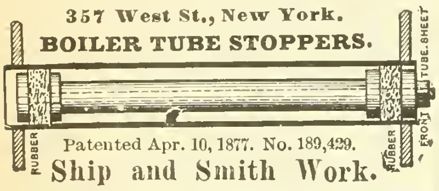

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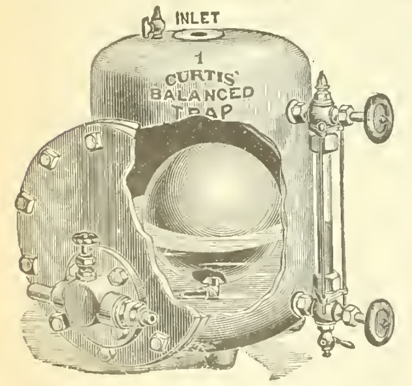

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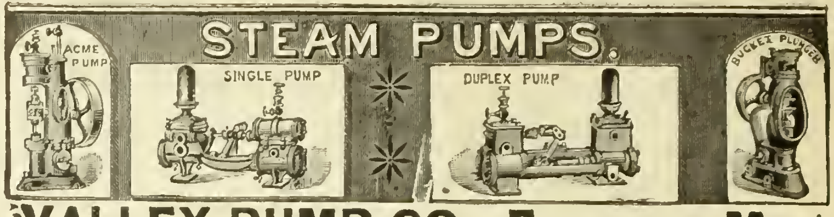

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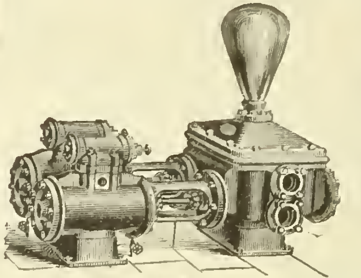

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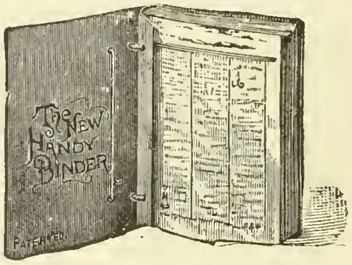

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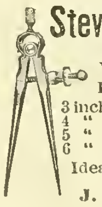

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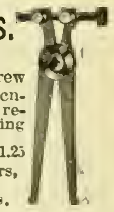

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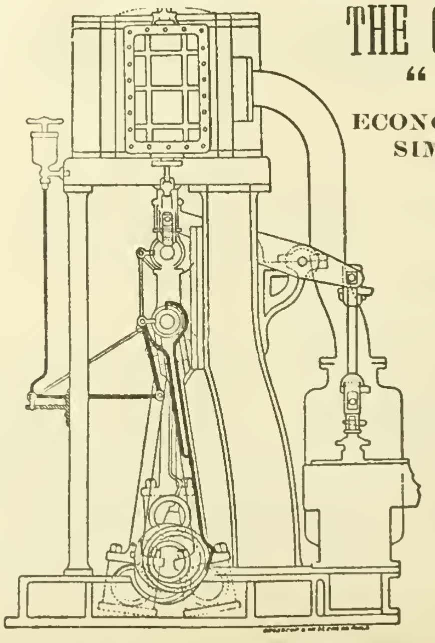

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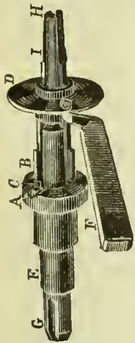

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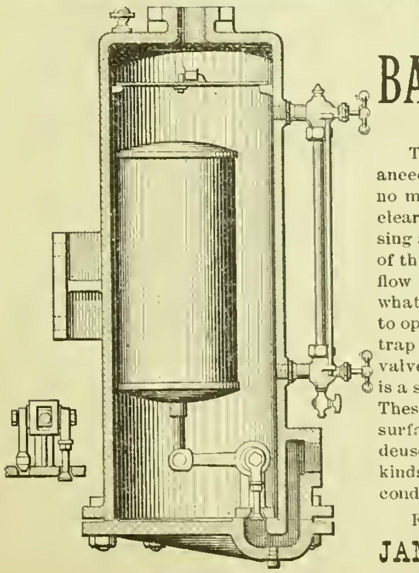

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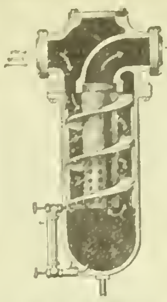

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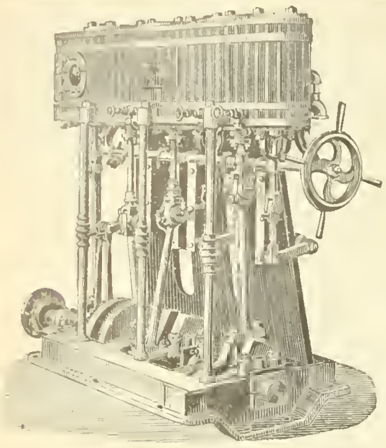

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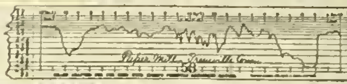

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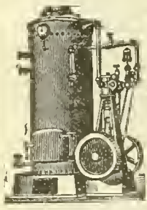

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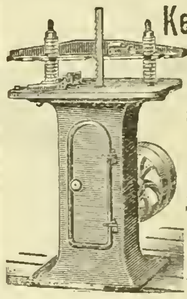

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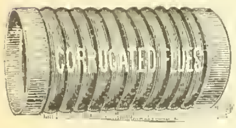

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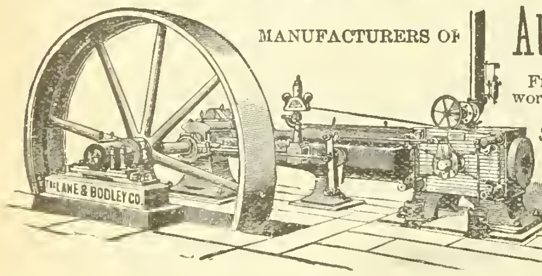

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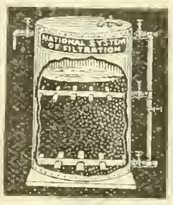

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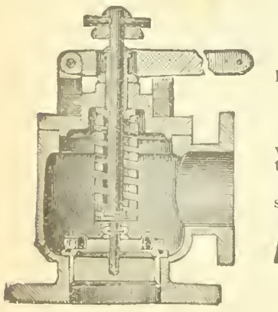

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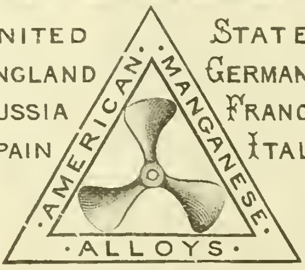

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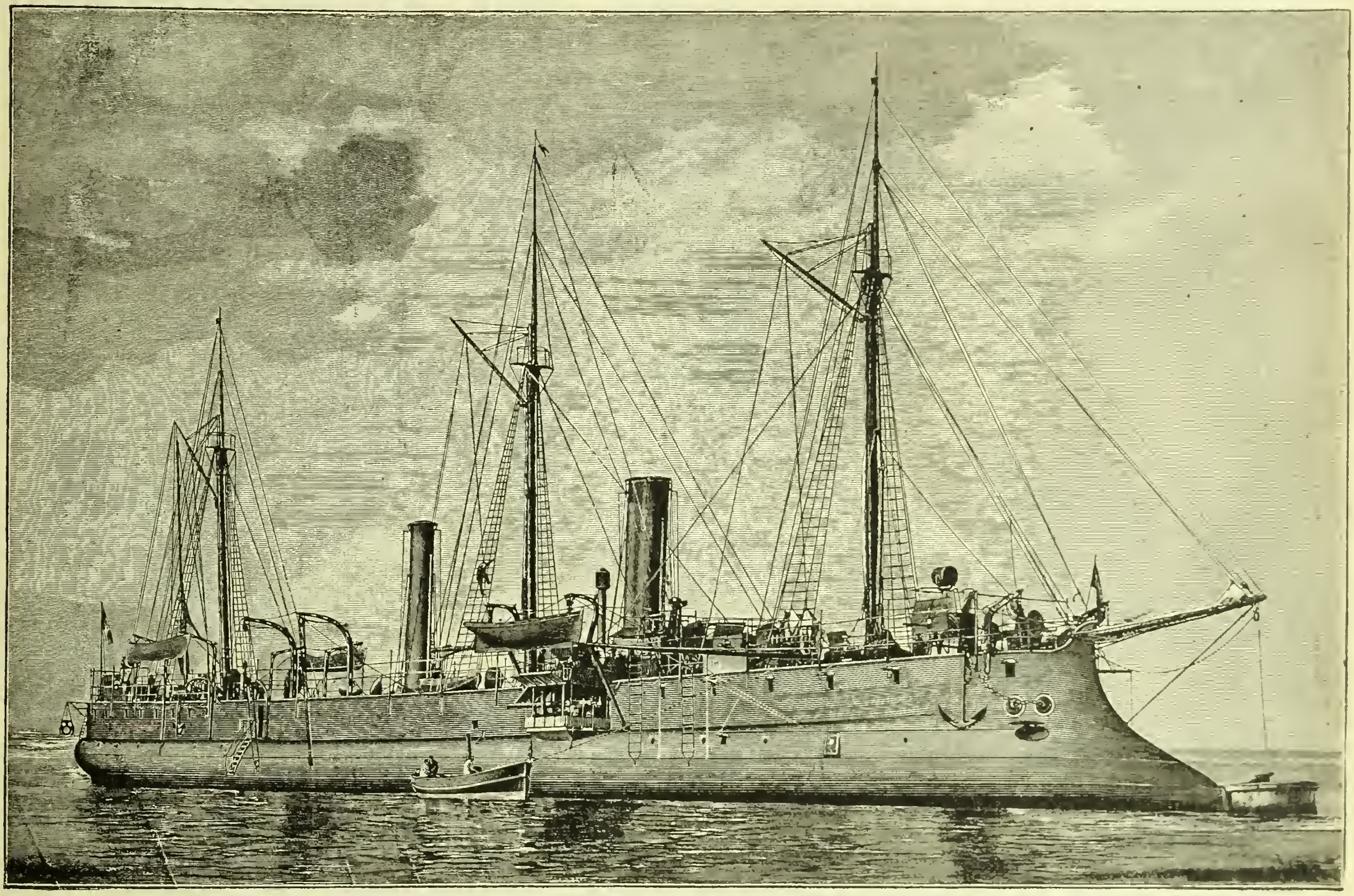
THE ENGINEER.
NEW YORK
New Series, 1883, 1888. **Vol. XX. No. 1.**
Tenth Year of Publication.
STEAM ENGINEERING, APPLIED MECHANICS, AND THE ALLIED ARTS.
$2.00 per Annum. - Single Copies, 8 Cents.
July 5, 1890.

THE 'FORBIN.'

The '*Forbin*' is one of the most recent developments of the French Navy; she belongs to the unarmored type of third-class barbette cruisers, and is one of sixteen coming under the same category, though differing very widely in size, form, and efficiency. With a small displacement (under 2,000 tons), they possess relatively very great engine power and high speed; the coal storage is low, only 200 tons, but they have a large sail area. They are not burdened with armor protection, except for the 1.5 in. steel deck, but they are belted with a caisson of cellulose, which it is considered will be of great utility without adding much to the weight. The armament is only moderate, but very efficient, consisting of 5.51 in. guns, machine and quick-firing guns. With the rapid progress now being made in the size and construction of the last named class of weapon, it is probable that the number of these guns will be increased, and heavier calibres introduced, so that it is likely the main armament will consist of 15-centimetre quick-firing guns. It is evident that the '*Forbin*' and her sister ship are highly successful experiments, which will be repeated with considerable modification at an early date.



A writer in *La Marine Francaise* has recently published a somewhat severe criticism on the '*Forbin*'; we cannot do better than summarize what he says on the subject to convey an idea of the appreciation of French critics upon this particular example of modern third-class cruisers. The '*Forbin*' having given a speed of 21 knots during a two hours' trial, and having proved that she could sustain this speed for a much longer period, or at all events that she can be safely classed as a 19-knot ship for fine weather, she is entitled to be reckoned as the fastest ship in the French Navy. She is propelled by two horizontal compound engines supplied with steam from six boilers, and develops a total force of 6,000 horse-power, which are used to drive two screws at a speed of 140 revolutions per minute. Viewed from the shore the '*Forbin*' has the appearance of a torpedo cruiser, but larger and much less sightly; her two funnels are of different sizes and are quite vertical; they offer a great contrast to the slight and badly arranged schooner rigging. There is nothing in the form of the ship that suggests that it possesses high speed; the lines are generally unattractive as seen from the water, and she is evidently not adapted for bad weather. If, however, the '*Forbin*' is examined in a dry dock these impressions are considerably modified, and the lines suggest much originality and boldness of ideas which have been justified by the high speed obtained. Extremely fine forward, the form of the vessel suggests that it is better adapted for speed than for manœuvring; the distribution of weights is such as to give the ship a tendency to pitch heavily, and this tendency is increased by the very large diameter of the two screws—a diameter adopted to compensate for the comparatively slow speed at which they are driven—which also helps to keep the ship down by the stern. This low engine velocity is one of the weak points of the ship, which would certainly be better adapted for heavy seas if the screws could be driven at 200 revolutions instead of 140.—*Engineering.*

◆

There is a touch of the grotesque in the tale of a passenger on the '*City of Rome*' when she made a landing at Fastnet Rock, a place where there are no facilities for such a proceeding. The passenger says that when the ship ran into the rock, the light-keeper ran out in his night clothes, and berated the steamship people for disturbing his rest at unseemly hours.

◆

On receipt of two cent stamp, the Mason Regulator Co., of Boston, Mass., will forward a case in which stamps may be carried without sticking.

TAKE NOTHING FOR GRANTED.

I HAD occasion a few days since to temporarily care for a steam plant. The regular engineer wanted to take a little vacation, so asked the writer to "chase the oil-can" for him while he was gone. "Everything is all right," remarked the regular engineer, "all you will have to do is to stop and start the engine, and see that the fireman keeps up steam." The above is pretty good advice for any engineer to give. How did he know what would happen during his absence? No man knows what is going to happen, and it is lucky that he doesn't. If people had the knowledge of future events, most of them would shake in their boots and be utterly worthless for all time to come, especially engineers who give advice like the above.

The advice in question was not accepted by the writer, and subsequent events prove that he did well in rejecting it. His first performance, upon taking charge of the plant and after getting well started up, was to trace out every pipe about the plant; every steam connection and every water connection was hunted out and a sketch made of the whole business; especially was the feed water supply studied. The different methods of obtaining water were examined until perfectly understood. The exhaust injector, the inspirator, the steam pump, and their various sources of supply, were all worked out.

The main supply was received from a well, a deep well pump elevating the water into a tank, from which it flowed to the pump or injector. City water was also available, but would not flow into boiler against pressure carried. One morning, when everything was running nicely, the exhaust injector suddenly ran short of water. Inspection revealed the deep well pump out of order, and in all probability half a day would be needed for repairs. The city water supply was turned on, and after running half an hour, notice was given that the supply would be shut off four hours to put in the new hydrant.

Here was a case that the engineer had not thought of when he said nothing would need to be done excepting starting and stopping and looking after the fireman. In looking over the plant I had found connections whereby hot water could be taken from boiler blow-off and forced through a hose for thawing out pipes. It was also possible, by means of valves, to connect the blow-off with the donkey feed pump. The blow-off pipe ended in the tail-race, about three feet above surface of water. It was only ten minutes' work to clap on an elbow and screw in a perpendicular pipe, making connections between blow-off pipe and water in the canal.

Upon starting up the donkey pump, a plentiful supply of water was obtained and forced into the deep well pump tank, after which it was used by the exhaust injector. Had the writer not looked over the plant he would not have been able to make this connection. The work must have stopped while the deep well pump was repaired, and many dollars of valuable time lost. It is a good lesson to engineers. They should never take anything for granted; always find out for themselves a way for knowing they are right; then go ahead.—*James F. Hobart, in American Miller.*

◆

THE articles by Charles E. Emery, Ph. D., on the form and designing of steam machinery, embody the latest and best ideas on the subject. Mr. Emery is not only a successful designer, but an assiduous student, and fully informed of what has been done.

◆

THERE are only 5,384 patents extant for metallic packing. Fact.

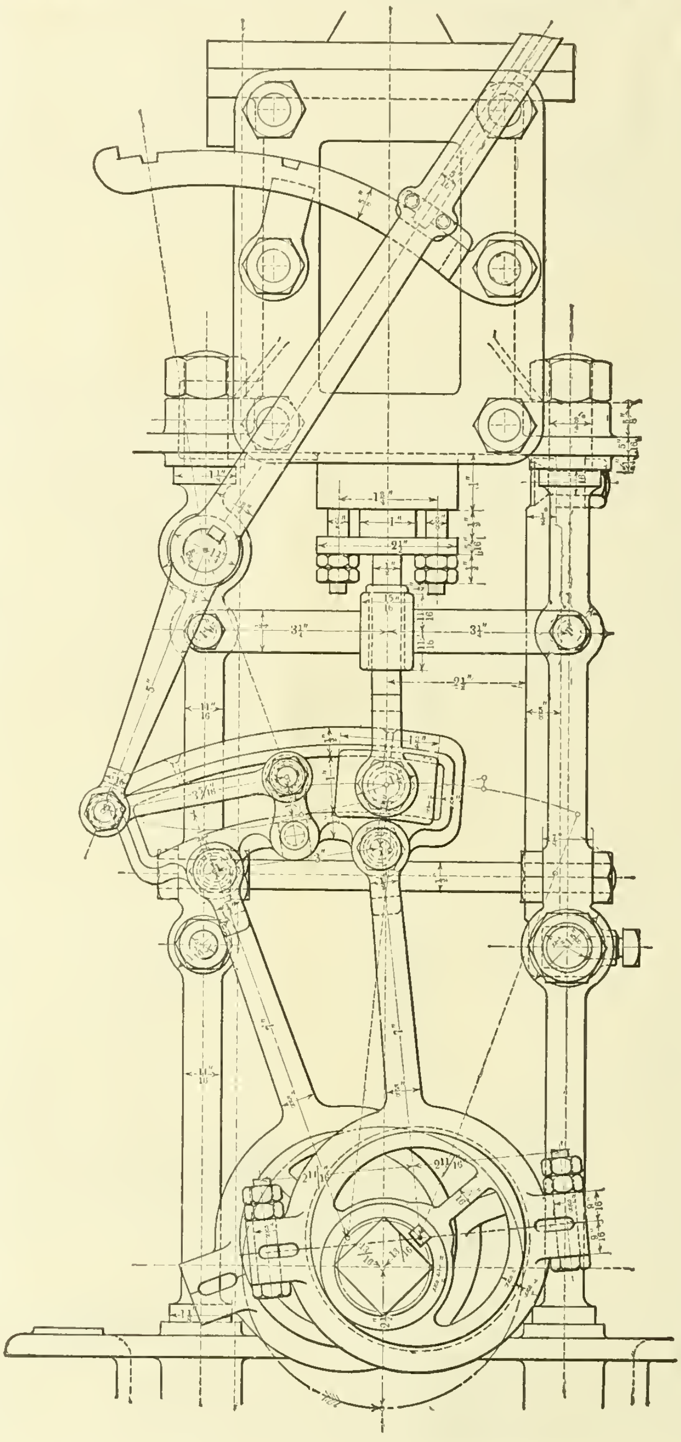
HERE is the leaky locomotive throttle again. A drill engine standing on a turntable of the New Jersey Central Road at Newark, lately, suddenly started off and ran into the rear end of a saloon. at the corner of Mulberry and Hamilton Streets. It tore down fifteen or twenty feet of fence, and then crashed into the kitchen of the saloon. The company will pay about $200 damage.

◆

COMPOUND CONDENSING LAUNCH ENGINE. No. 1.

By the Bureau of Steam Engineering, U. S. N.

THE drawings herewith show a type of engine which has done good service, and was designed by the Bureau of Steam Engineering, U. S. N., for navy launches, which are about 40′ long by 8′ beam. These particular engines which we illustrate here are 4″×7″, and suited to a launch 35′×7′. All details will be given



◆

PRACTICAL ELECTRICITY waxes wroth because a maker of birch beer in Boston undertakes to give an expert opinion on electricity—but our contemporary should keep cool; it does not know what we have to stand down here. A city paper, which pretends to be practical, publishes this in its last issue:

> "The fires were at full blast. the gauge of the huge boiler, one of the largest of its kind in the city, indicated shoal water, and the engineer was stretched on the ground, stupidly drunk. The heat of the place was intolerable, and the radiation from the walls of the boiler showed that it might burst at any minute."

Eh ! what does it think of that, now ?

PUBLICITY.

THIS matter we dislike to allude to, for it sounds very much like an appeal to advertisers, but it is unreasonable to expect buyers when they do not know of the existence of a concern. Many rely upon circularsand upon the actual work of travelers, but the poorest paper in the world can give more publicity than all the circulars and travelers that a concern can afford to put out. Travelers are very costly attachments. No one can travel for less than $6 a day, exclusive of salary, and even then they reach at the best but half-a-dozen people daily. When the traveler is gone his work is forgotten the circular, if read at all, is usually thrown away, but an advertisement cannot be gotten rid of. It stares one in the face always, and whether the goods are wanted now, or on some other day, it is remembered and answered. Often enough the man who reads it never uses the goods, but tells some other man who does. Don't expect trade to come in unless traders know that you are in the market.

◆

CONCERNING labor agitations Bismarck recently said this: "Did you ever know a banker with a million who was contented ? or a scientist, politician, artist, lawyer, satisfied with his gains and position ? I will go further, and ask you, have you ever known a contented man ? I mean among the rich, the successful, the highly born, or highly placed ? How then shall the workingman be contented, whose life is necessarily one of few pleasures and many troubles, of frequent privation and rare indulgence? The more operatives get the more they want. I don't say that it is not natural, nor that they differ from other men in this respect; but the fact remains. Let what real grievances they still have right themselves by natural processes, as they will gradually and in due time. Above all, let them continue to improve their position without State interference, which can only do them more harm than good, besides inflicting irretrievable injury upon numbers of other people, quite as worthy of consideration as artisans."

◆

A HORSE-POWER is 16½ tons raised or lowered one foot in one minute. This is the standard measurement of power now adopted in all countries where power is bought and sold. Suppose we have a weight of 33,000 lbs. suspended in mid air. Then if this weight falls freely through space and drives a drum, through a rope or belt, it will give out one horse-power for every foot it falls each minute. In order to furnish 100 horse-power, then it would have to fall 100 feet in one minute; for one hour's steady work it would have to fall 6,000 feet. This seems rather discouraging to those who are trying to get power by falling weights, particularly as we have given only the net results, deducting nothing for friction of gearing, which would be necessary to reduce the motion.

◆

A NEW system it seems has obtained under the present administration, of stocking Government machine shops with machine tools. A board of experts has been appointed by the Secretary of the Navy, who are, as we understand the matter, to report upon the relative values of the tools offered under the several bids put in by machine tool makers of the country. Heretofore the lowest bid was accepted, but now it appears that the best bid is to be accepted regardless of figures. This is certainly a great advance, and should result in stocking the shops with the very best tools. The value of a tool has very little to do with its actual cost; the latter may be nominally high, as prices run, but it may be low as regards the intrinsic value of the machine itself.

'THE 'PHILADELPHIA,' U. S. N.

THE United States cruiser '*Philadelphia,*' has proved herself, apparently, the fastest warship of her class afloat. The average speed maintained for four hours of the test, June 25, was 19.512 knots. To this will be added the corrections and allowances for currents, which those on board of her during the trial say will give an average speed of twenty knots for the four hours. This will give her builders a premium of $200,000.

While the members of the official board are bound to secresy, they admit that twenty knots an hour is about correct. Although the performance of the '*Philadelphia*' over the measured course was remarkable, the tests she was put through afterward at the request of the Naval Board were no less remarkable. During the whole run she averaged eighteen knots an hour under natural draught.

The most difficult test the '*Philadelphia*' was put to was reversing the engines while running at full speed. While under a full head of steam and running at a high velocity the engines were suddenly reversed and the ship brought to a full stop. The engines and machinery stood the test perfectly, and not a bolt was started nor a shaft strained. This is the most severe test possible to give engines, and is never resorted to unless in the greatest danger, as it nearly always results in damage to the machinery. With two boilers with banked fires, and a forced draught on the other two, the '*Philadelphia*' made eighteen knots an hour. With a natural draught and four boilers in service she maintained with ease eighteen knots an hour. During the cruise the engineers comprising the board took frequent data for future reference. The horse-power developed by the engines and the amount of coal consumed were especially interesting, and a report of the results obtained will be furnished to the Secretary of the Navy.

◆

STATIONARY steam power, which was but little used in New England fifty years ago, is now found everywhere, needing careful and systematic oversight, and when *The Locomotive* shows, as it does, that 18 per cent. of the reported defects of boilers in the year 1883, for instance, were dangerous, while the percentage of such cases in the year 1889 was only 8, we must conclude that the watch and ward of the Hartford Steam Boiler Inspection and Insurance Company over its risks is doing a valuable service. The tabular statements, in *The Locomotive,* of reported defects for the years above specified, when compared in details, show that in nearly all of the items there was a marked decrease in the percentages of the dangerous cases, but the only item we will here notice is that of defective riveting, showing 18 per cent. in 1883, and only 3 per cent. in 1889, a very striking exhibit truly, as to one of the main points in boilers.

◆

As soon as the President approves the Naval Appropriation Bill a circular to shipbuilders of the country will be issued from the Navy Department regarding three new battle ships. The minimum speed is fixed at fifteen knots, and the same penalties will be exacted and premiums offered as in the case of the '*Philadelphia*'—$50,000 for every quarter knot. The length will be about 350 feet, with 68 feet beam. The displacement will be about 9,000 tons. The torpedo outfit will be complete, and the scheme provides for a heavy belt of armor 18 feet in length, 17 inches thick. The turrets will be of 18-inch armor, and two of the 13-inch guns will be mounted in each turret. A greater radius will be given the 8-inch guns by placing them in the tier above the 6-inch guns.

REVERSING GEAR FOR SMALL YACHT ENGINES.

MESSRS. RILEY & COWLEY, builders of high-speed compound and triple expansion engines, Richard and Bowne Streets, Brooklyn, N. Y., have designed a reversing gear, illustrated in figs. 1 and 2, and applied it to many small engines for steam yachts and launches. We are indebted to the *American Machinist* for the loan of the engraving; in their columns it first appeared. The device works very satisfactorily; it does away with half the number of eccentrics and rods, and is well adapted for small compound or triple expansion yacht engines, or engines used for other purposes.

In small compound engines, two eccentrics are placed close together and keyed to the sleeve *A*, which is free to rotate on the end of the crank shaft *B*. One of the eccentrics operates the valve of the low-pressure cylinder directly; the motion of the other eccentric is transmitted by means of a rock shaft to the valve in the high-pressure cylinder. The sleeve *A* has a spiral slot *C* cut in it, which engages with a pin *D* firmly screwed into a second sleeve *E* (part of this sleeve is shown in section in fig. 2). The pin *D* also works in a longitudinal slot cut in the shaft *B*. In order to reduce the friction, the pin *D* is provided with two loose bushings, as shown in fig. 1, one working in the slot *C*, and the other working in the slot cut in the shaft. A number of grooves are cut in and around the sleeve *E*, which engage with corresponding projections on the back of the rack *G*. This arrangement forces the sleeve *E* to rotate with the crank-shaft, and allows the rack to slide it along the sleeve *A*. The rack engages with a pinion keyed to the vertical rod; at the other end of this rod a hand-wheel is attached so as to be in a convenient position for the engineer. In turning this wheel the rack is moved in its bearing, and causes the sleeve *E* to slide along the sleeve *A*. The pin *D* being firmly fixed in the sleeve *E*, and engaging with the spiral slot *C*, causes the sleeve *A* to rotate on the crank-shaft, and sets the eccentrics into a new position, thereby reversing the motion of the engine.

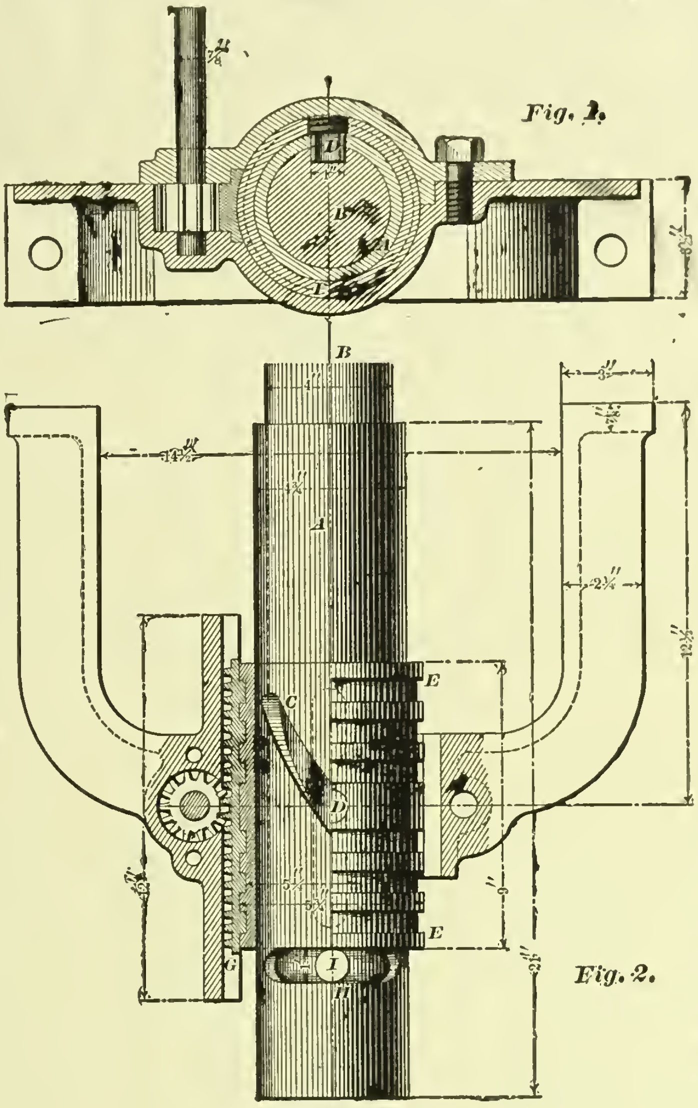


Fig. 1.

Fig. 2.

Reversing Gear
For Triple Expansion Engine
6"×10"×16"×10"

The pin *I*, driven into the crank-shaft, and working in the slot *H*, serves as a stop, and prevents the eccentrics from being set over too far; this pin also prevents a longitudinal movement of the sleeve *A* on the shaft.

For a triple-expansion, the principle of the design of this gear is not changed, the only difference being that three instead of two eccentrics are keyed to the sleeve *A*. One of these eccentrics operates the valve in the low-pressure cylinder directly, as before, and the motion of the other eccentrics is transmitted by means of rock-shafts to the valves in their respective cylinders.

In some of the larger engines it is sometimes necessary, for the convenience of the engineer, not to key the hand-wheel to the vertical rod, but to key it to a horizontal shaft, and transmit motion to the vertical rod by means of a pair of bevel gears.

◆

SETH BOYDEN was the acknowledged founder, if not the inventor, of patent leather and malleable iron, and as a machinist showed wonderful genius and talent. He was a man of generous heart and simple life, satisfied to let others reap the harvest of his inventions and enterprises. He was identified with the earliest railroad enterprises, and contributed no small part to the list of railway inventions. In 1837 he built two locomotives for the Morris & Essex railroad, the '*Orange*' and '*Essex,*' which are alleged to have been the first engines built in New Jersey. The '*Orange*' surprised the railroad world by drawing a train up a grade of 140 feet to the mile. Both engines were successfully run many years. In 1841 he built an engine for a company in Cuba, and went there to put it in operation. He called this the '*Cometa.*' It is well established that he was the first to place a driving rod outside of the wheel, in place of the crank axle inside. Although his claim to this invention has been questioned, Cyrus Currier, his business associate, says: "Nowhere can I find evidence to destroy my belief that Mr. Boyden was the first to put in the straight axle." Boyden considered his invention of the link motion and cut-off as his greatest addition to the steam engine, but when applying for a patent he was informed by the patent office that he must furnish a model; he characteristically paid no further attention to the matter. In the drawings of his second locomotive, the '*Essex,*' which are still extant, will be found a duplex valve gear, such as are now used in duplex steam pumps.

◆

Is the electric light a manufacture? This question has been repeatedly asked, and, so far as we know, it has never been answered satisfactorily. Not long ago, a legislative act, in the State of Pennsylvania, removed the tax from manufacturing companies. Subsequently, the Philadelphia Electric Lighting Company, and the Brush Electric Light Company, both doing business in Philadelphia, found that they were not exempted from tax under the aforesaid act, and refusing to pay the tax, were sued by the Commonwealth. The plea made was exemption on the ground that they were manufacturing companies. The issue has been argued before Judge Simonton, at Harrisburg, and, in its decision, the court holds that "there is no manufacture when a similar substance is not produced; and that, as neither electricity nor the electric light is a material substance, no manufacture exists in the cases offered for its consideration." It is stated that an appeal from Judge Simonton's ruling will be taken to the Supreme Court of the State.—*Practical Electricity.*

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

THE LOG OF THE BUTTERCUP, No. 3 STEAM LAUNCH, WRITTEN UP BY THE LADY CHIEF-ENGINEER.

Editors ENGINEER:

What are the duties of an engineer when he first takes charge of a boiler? Is it not to inspect it very carefully? If I am right, I wish there was a law that would first force stationary engineers to pass examination and to take out licenses, then to report to competent authority the condition of the boiler they are engaged to attend. It would prove the saving of many lives and much property. There should be another law, should there not, requiring the owners of stationary boilers to submit them to inspection?

An acquaintance of mine was foreman and engineer in a machine shop; he had an old boiler to look after, which he cleaned every month. The deposit was white and hard, resembling porcelain (what was it?) He considered the boiler unsafe and so reported to the owner, and was snubbed, but he continued to report. One day having occasion to blow out his water glass he found that the connection had rusted off; part fell into the boiler, and the rest, well, it had vanished. They had sport for a while, and the result was that my friend moved into another shop, severed his connection voluntarily with the owner who would not get a new boiler, and also moved his family to a safe distance. This reminds me of an engineeer who was fatally injured by a boiler explosion. He was given over to die, and his friends had called to bid him a last farewell. Among them was his former employer, the owner of the exploded boiler, who remarked: "They tell me, John, that the doctors say you have got to die; well, I'm sorry for you, but when you are in heaven you can look back and see with satisfaction that I have got a new boiler at last."

There is a moral to all this which I need not dwell upon. I may record it later. Were the public aware of the dangerous proximity of many of these unsafe boilers, it seems to me there would be some action taken to remedy the evil. I have little respect for a dangerous boiler, but great respect for one that I know from my own inspection is safe. Take a safe boiler that steams well, does not leak, and is kept clean, there is some comfort handling it. Your frequent comments on dirty boilers and engines meet my ideas exactly. Our boiler aboard *'Buttercup'* was reliable every way, responding to all requirements faithfully. I have often heard engineers that we chanced to have aboard comment on its ready steaming qualities. With a good fire we got all the steam we could use on a perfectly calm day; when "the fresh'ning breeze piped loud and free," we would regulate steam by partly closing our damper. There is great satisfaction in all this.

We once had aboard on a trip a very intelligent engineer of a towboat. He looked after our fire and saved one-half bushel of coal. We formerly had used three bushels on the same trip under the same conditions; this day only two and a half. He was a scientific fireman. I got an idea there, and made a note of it. When I read of the enormous amount of coal burned on big steamships I wonder if the owners realize the importance of employing good firemen? Here's a place where good pay pays. This little knowledge has saved me a ton of furnace coal the past winter.

After all, a well fitted steam launch is a good place to serve time in. Much information on engineering can be gleaned, and many valuable lessons learned. The unexpected is just as likely to happen here as on a larger boat; it may not be so disastrous, but it calls for close attention all the same. For a young engineer seeking information, unusual facilities are also offered for experiment and investigation. What better place for gaining knowledge of the indicator—knowledge that all engineers should have, though too many sneer at it.

By the way, Messrs. Editors, did you ever consider the twin brotherhood of the indicator and the sphygmograph, the physician's indicator of the human heart power? The consideration is an interesting one. You doubtless know the instrument is fastened to the wrist, and a paper recorder on a traveling slide receives the pencil tracing of the pulse waves, even as the indicator records the action of steam. A perusal of these pulse-cards would interest an engineering student. From one of my husband's medical journals, now before me, I notice a card indicating the "Myocardiographic and apex beat-curves, taken with subnormal arterial pressure." I see where the heart "cut-off" begins and the "return stroke," as it were, commences, the lack of compression, the angular lack of cushioning, the quick admission, and the further tracings, the falling of initial pressure, and the vibrating lines of a too weak spring, or perhaps a failure of "expansion," indicating a weak apex beat, or say, a complete drenching of the cylinder with condensation. My technical terms may not be official, but I trust you catch my meaning. But to return:

What a good opportunity there is for the study of fuel in these small pleasure boats, of boiler and engine efficiency, of valve and cut-off, and expansion, results of economy, etc., etc.! A little thought, a little study, a little consultation with men who can instruct, and the perusal of journals and books on the subject, will give a novice a good start in the very fascinating profession of engineering.

I am a believer in hobbies. They serve to rest the mind; they are safety-valves to overworked brains; they switch off the thought to another track, and serve to rest and to entertain, and to instruct, too. If I want to find a happy man I seek a man with a hobby. They are the ones who are nearest to Arcadia, so I advise all workers (and we are all workers in one or another way) to get a hobby. My hobby, as you know, is engineering. It affords me comfort and rest. I am thinking seriously of attending the free evening drawing school the coming winter, and taking a course of mechanical draughting, and, if you will believe it, I'd like experience in a machine shop. When my son becomes a student in the Institute of Technology, I shall follow along pretty closely with him in his studies. We all live and learn, or should, and so my hobby serves, nor time nor custom withers it. Young reader: get a hobby; you will be happier, and wiser probably.

Eruditus has a hobby—naval architecture. The walls of his room are covered with designs of vessels of all classes, launches, towboats, steam yachts and their cabin plans, forty footers, catboats, flying proas, etc. I am sorry to say he has another hobby—baseball. But he's young, so there is hope.

This leaf from the log book relates to *Eruditus.* Time, July, 1888, age fourteen nearly. *Eruditus* had been "sitting up o'nights," reading about *Deerslayer* and *Chingachgook* and the *Horican*, and I don't know how many other books on the subject, until he became imbued with the spirit of camp life. He would become a modern pioneer; he would have a camp on the wooded banks of the Kennebec. Instead of scalps he would cover the walls of his tent with the skins of squirrels and woodchucks, possibly mink. Fish! he could do as the primeval man did; even the dugout could be secured.

Filled with this desire he gave us no peace until he got his outfit. It was on a Saturday morning that he started on his trip; he had chartered *'Buttercup'* and her crew for the occasion; in fact he had full command of the expedition. His party consisted of a chum two years older than himself, enlisted as a companion and co-worker; the latter was the worker, *Eruditus* the "co." The two had worked hard that morning in getting their traps aboard, and *Eruditus,* full of excitement and the cares of so responsible an undertaking, was giving orders and instruction faster than any ten men could execute them. His naturally sober face was careworn and his temper irritable.

It was a proud and happy moment for him when he ordered his chum to "Cast off there, Austin, now, and be quick about it!" But, before we start let's see what we have aboard!

First, *Eruditus* in command of the ship; his chum as assistant. Our captain was for this trip sailing master and crew. I was the engineer. In forward was stowed a 10′×15′ tent, poles, pegs and covering; two camp-beds and three double blankets each; bushel baskets containing cooking utensils and camp outfit; numerous pails, buckets, kettles, baking tins, oil stove, fryers, broiler, etc.; about everything one could think of; had I not watched carefully, some of my choice china would have been included, for *Eruditus* hesitated not to capture anything and everything that would contribute to his comfort while camping out.

This appropriating desire (to call it a mild term), I am sorry to record, was hereditary. An ancestor of his was noted, as a youth, for appropriating wearing apparel of his mother's, no matter what it might be, and making of the same presents to others. For a long time the mother could not imagine what became of her dresses, cloaks, shawls, stockings, skirts, etc., nor could she then discover; but, in later years, the culprit acknowled his guilt—to her horror and other people's amusement. Thus, knowing something of the laws of hereditary transmission, I kept an eye on my china ware.

Beside the camp outfit, there were groceries and provisions enough to feed two hungry boys, and what company they might have during their two weeks' outing. There were tools, hatchets, axes, guns, revolvers (very necessary adjuncts, these last two), and all the rest of the usual unnecessary accompaniments of such expeditions. Last, but not least, was a nondescript boat astern. *Eruditus* had discovered it in a loft, and considered it a rare streak of luck when he secured it for two dollars.

It was with some surprise, when he saw it launched, that he found it would not float, but filled immediately with water. This, he explained to us, was only temporary; that the seams would swell up in a day or so and the boat would be tight, but its twenty-four hours' immersion had not perceptibly lessened its bibulous tendency.

It was an old soaker and could not be got tight, only full, and full it remained. It was a down-east skiff, about twelve feet long, and some three feet beam, turned up at both ends like a scow. In fact, it was a small scow, good for carrying, but bad for speed, and about the hardest thing to row or paddle I ever saw. This marine *rara avis* was to contribute to the two heroes' comfort!

'Buttercup' was well loaded as Austin cast off, and *Eruditus,* at the wheel, gave one bell, calling out at the same time to Austin to lay aft and keep an eye on the skiff. In response to orders I gave steam, partly throttled, until we were well underway; the partially submerged, wabbling boat at the stern requiring all our attention. Well out into the river I gave full steam, and *'Buttercup'* sprung to her work, lashing the calm water into wave lines, eddies and foam. Almost immediately Austin startled us by the outcry:

"She's sinking!"

I turned, and was surprised to see the bow of our nondescript nearly on top of our awning, and her stern a foot or more under water. Was she coming on board, or was she going down stern foremost? I thought it best to lessen speed, and was about to do so when my eyes rested on *Eruditus.* He had just caught a view of his precious charge astern; an expression was on his face I had never seen there before; utter astonishment, bewilderment, fear; and then the orders flew thick and fast for a few moments. He was omnipresent, here, there, and everywhere, stirring up utter confusion by his reckless jumping about and his imperative orders. I thought overloaded *'Buttercup'* would surely roll over. I got excited myself, and called on my husband (who alone remained unconcerned, and much amused), to make our son behave himself. For a moment all was excitement, until the skiff, being emptied of water, rode somewhat easier. The little occurrence started us all to talking, and *Eruditus* had many a joke given him regarding his lucky purchase.

Fourteen miles up river we journeyed to the camping ground, the most beautiful place on the river, if not in New England. The reputed former home of the beautiful Indian maiden Jacataqua, the Queen of the Kennebec, the friend of Aaron Burr, whom she met as he journeyed up the river with Benedict Arnold on their raid to Canada. Selecting so beautiful a spot for her home, we can well understand that Burr was correct in pronouncing her poetic, intelligent, and a worthy queen. It is recorded that her wit equaled his own.

On this spot, poetic with Indian legends, *Eruditus* pitched his tent—or rather his father, an Adirondack camper and shanty-building expert, pitched it for him, while *Eruditus* stood by and directed how he wished it done, until his father's patience was nearly exhausted. I busied myself in attending to the culinary department. As the afternoon waned, we had accomplished much, and I finally started the oil-stove to prepare the banquet. The odor of cooking was too much for *Eruditus* to withstand, and he began eating supper two hours before it was ready. We sat long at the table until the hour of departure arrived. The two boys looked a little sad when we gave three blasts of the whistle as a farewell, and *Eruditus* declared afterward that he never before was so homesick.

We promised to give them a call on the following day, but the call was never made, we were called on instead. The prodigal returned, and a sorrowful story he had to relate. Like old frontiersmen, they retired at sundown; sleep visited them not; the night shadows lengthened, the silence became oppressive, intensified now and then by the hooting of an owl or the leap of a sturgeon from his watery home. Now and then they took a peep into the inky blackness of night, only to realize the loneliness and to wonder if morning ever would arrive. As the night advanced the chill and dampness seemed to increase. *Eruditus* had piled all available clothing over himself, and wondered why under so much weight he could not keep warm, forgetting or not noticing that only the thin canvas sheeting of the cot bed was between him and the cold, fog-laden air. Thus time passed until midnight, when they concluded to return to civilization, voting life in the wilderness a failure, and ready to thrash anyone who spoke of its fascination.

Baling out the leaking skiff, the only conveyance they had, was no easy job, but it was finally accomplished, and no time was lost in starting for home. It was all they could do to keep *'Rara avis'* afloat; *Eruditus* had to do all the rowing, as his companion knew nothing of the art; it probably did not serve to make him or the journey agreeable.

I know from sad experience what a poor laborer *Eruditus* is, but call it "athletics," and few can excel him in industry. A twenty-mile walk to get his muscles in trim is nothing. "O, no! not tired at all, go it all over again easy!" but asked to mail a letter at the nearest corner, or to bring up a hod full of coal, and he "goes to pieces," and groans as if chronic rheumatism had him as its victim. But to do him full justice, he loves to study, and he learns thoroughly his French, algebra, geometry, etc.

That eventful night's row must have been a hard one. *Eruditus* was very reticent regarding particulars, but it was easy to see he had had enough of camp life. The mink-skin gloves promised me I have not yet received. The day following the morning of his arrival was spent in sleep. The next we devoted to striking camp, and *'Buttercup'* was again chartered. Those utensils we still have stored. The skiff remains on the shore where it was abandoned. The incident itself passed into a memory. "And what is writ is writ, would it were worthier." "

MRS. BUTTERCUP.

Boston, Mass.

[We are glad to receive this continuation of the log of the *'Buttercup'*, s. l., and are pleased to record the fact that all of our professional readers with whom we have come in personal contact express their admiration of the ready wit and fertility of resource of the author of the log, but (there is always a reverse) they utterly and obstinately refuse to believe that the author is a lady; and when we insist upon it that this is the fact, our assertion is received with polite, but very positive, incredulity. Even an affidavit, we fear, would have no weight. Many of them accuse us of amusing ourselves in hot weather by writing these letters! We don't know what to do about it.—EDS.]

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GAS IN STEAM BOILERS.

Editors ENGINEER:

At varying intervals we have read articles in technical journals relative to explosive gases in steam boilers. Most modern writers affirm that the gas theory is a fallacy, and, as far as they go into the question, submit proofs damaging to the prestige of the so-called "gas crank." However, this much-mooted question is capable of further development when carefully considered, and I think that the most skeptical engineers can be convinced that gas really exists in many boilers running without surface condensers, and is the cause of quite a number of disastrous explosions annually. I do not wish to be understood as taking exception to your views of the question as set forth in No. 11, last vol., of THE ENGINEER, in the article entitled "*Dangers From Gas in Steam Boilers,*" but on the contrary believe it to be true in every particular. The theory advocated in this article has no connection with the article referred to. It is a well known fact that water has a great affinity for gases, and that they will diffuse themselves to a fixed degree through liquids, the point of saturation being influenced by temperature. Chemistry teaches us that ammonia gas will dissolve in water to the extent of 26 per cent. by weight, decreasing the specific gravity of the liquid to 0.900, pure water being rated at 1,000. There appears to be no known law regulating the act of solution or determining the point of saturation of gases excepting the law of Dalton and Henry, who claim that "the weight of a gas dissolved by a liquid is directly proportionate to the pressure."

Consequently their solubility must be determined by direct experiment. Unknown quantities of carbonic acid gas may be said to be always present in feed water, inasmuch as it has been found in the waters of many springs. This is the gas which gives the sharp, agreeable taste to so-called "soda water," beer, cider, etc. Mention is made of these two gases merely as examples illustrating the absorbent qualities of water; therefore, it must be admitted that different varieties and quantities are present in all feed waters. Under certain conditions it may be shown that disastrous explosions can happen to boilers containing plenty of water; no destructive distillation or decomposition takes place, and no spark or flame is needed to produce the phenomenon. A short time ago Professor F. G. Fowler delivered a lecture before the members of St. John Council, A. O. S. E., of this city. His subject was Boiler Explosions, and was illustrated by practical experiments carried on in full view of the engineers. Mr. Fowler began his experiment by introducing two small tubeless shell boilers of the horizontal and vertical type respectively, which were placed over the flame of a lamp and steam raised to a pressure of 40 pounds per square inch. One of the boilers used contained water from which all air and gas had been extracted. The other one was supplied with water taken from the street mains without being subjected to any process; both boilers were filled about two-thirds full. When the steam gauge on the two boilers indicated 40 pounds, the one containing the hydrant water was removed from the flame and immediately inverted. Instantly the pressure rose to 84 pounds, and remained there for several minutes. It gradually fell when the boiler was restored to its original position. The boiler holding the pure water was then put to the same test, but no increase of pressure was apparent Steam was then allowed to escape from the first boiler and raised again to 40 pounds. When inverted the second time the gauge showed an increase of but 2 pounds only, showing that the water was free from gas. Mr. Fowler stated that during the past ten years he had made about 400 such experiments, and that the results were invariably the same. He claimed that the rise in pressure was due to the agitation of water impregnated with gases, and that the same phenomena could occur in factory boilers, He cited instances recorded by the Hartford Steam Boiler Inspection and Insurance Co., wherein it was shown that boiler explosions happened more frequently on Mondays than on any other day of the week. The reason given was that the boilers were filled with fresh water from which the gases had not been boiled off. Therefore, it is patent to everybody that when boilers, known to be strong and well built, explode more frequently on Monday than any other day, some reason therefor must be given, and Prof. Fowler's theory must be accepted or disproved before another is offered. It is also on record that the sudden opening of throttle valves has resulted disastrously, boilers being burst at the moment of starting the engine. Any sudden liberation of steam from any steam generator is known to be attended with danger, inasmuch as a violent agitation is started in an instant. And further, what other theory than the one given can be admitted when an unsound boiler in a battery explodes, sometimes wrecking the entire plant by nothing more or less than the shock produced? Mr. Fowler is a strong advocate of the employment of the surface condenser as a means of preventing many of these "mysterious" explosions, claiming that by its use the feed water is being constantly de-aracted by the continued process of boiling. It is seldom that we learn of the destruction of a marine boiler, except it be due to weakness or defects in the boiler itself and easily traced to them. The lecturer also demonstrated that the violence of boiler explosions depended in a measure on the condition of the water used, gaseous water being the most terrific in its effects. To prove this he had constructed two boilers, duplicates in every respect, and tested them hydrostatically to nearly their bursting pressure. These were encased in wooden jackets, fac similes in every detail. After filling the boilers with the afore-mentioned waters, heat was applied and pressure raised till rupture of both took place. The results in the two instances were widely different. It was found on examination that the boiler which held the purified water had parted at the seams only, doing no injury to the wooden jacket beyond forcing it apart at the joints. The second boiler fared worse, being rent through the sound plates and shattered to fragments. The force of the explosion tore the jacket asunder and split a few of the boards of which it was built. Mr. Fowler concluded his remarks by stating that corrosion in feed pipes and boilers was mainly due to gaseous water, and exhibited samples of steel wire which had been immersed in purified water. Although they had been in the water for months, not the least sign of corrosion was perceptible, while, on the other hand, specimens were shown which were corroded after a bath of twenty-four hours' duration in water from the street mains.

In support of Mr. Fowler's theory, the writer has been favored with an opportunity for observing the effect of gases in a road-roller boiler of 25 h.p., at work upon a gradient of 10 feet in 100, using cold well-water for feeding. With the machine at rest on the top of the hill the boiler was fed by an injector till the water rose about 5 inches in the glass. The fire was deadened on the surface and making but little steam. Two or three strokes of the engine were sufficient to get under headway, and the machine would run down the hill at a dangerous speed if not checked. This was done by keeping the reverse lever in the middle notch, thereby causing the piston to cushion on air drawn through the exhaust nozzle. When near the bottom of the incline, the steam gauge pointer, which had been standing at 80, rose in the space of one minute to 108. The engine was then stopped, steam admitted, and the machine started up hill. After the engine had made about four turns, the pointer had fallen back to 80, at which figure it would remain stationary. This experiment was repeated a number of times, with about the same results, the more water fed into the boiler the higher the pressure when at the bottom of the grade. In instances when the boiler was not fed before or during its descent, the pressure would not rise more than 10 pounds. In explanation of this phenomena, it may be said that the increase in pressure was partially due to the agitation of the contents of the boiler and in not allowing the contained gases to be worked off through the engine as fast as eliminated. It should be borne in mind that a steam roller descending a grade is subjected to many sudden and severe shocks, which with the usual pitching that takes place. renders the water in the boiler anything but calm. There can be no doubt that in the event of the roller tumbling down an embankment, the pressure would, as in Prof. Fowler's experiments, be doubled, and, with a weak boiler, disastrous results would be apt to follow. Perhaps some of your readers. in explanation of this performance, will claim that the extra pressure was caused by air being pumped into the boiler by the piston. It is true that when engines using flat sliding throttle valves are running in the reversed position, a certain quantity of air is forced into the boiler through the throttle valve, and in Europe the most common form of this type of valve on locomotives is designed to avoid the extra pressure caused by running in the reversed position.

Bridgeport, Conn. QUID NUNC.

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INCREASING THE POWER OF A MARINE ENGINE.

Editors ENGINEER:

I have been a constant reader of THE ENGINEER for the last six years, and I subscribe to three other technical papers, among which is the London *Engineer*. Your paper, in my opinion, is the one to strike the nail on the head. I hope to see the day that you will make it weekly.

I am a boat-owner here (2 tugs), and several arguments arose between myself and engineers on compounds and triple expansions. Fuel here is worth almost its weight in gold, therefore a very small percentage in gain of power with the same fuel is quite an item in a season's work. One of the tugs has a compound engine, cylinders 12½ ×24″× 12″, 80″ boiler pressure, independent jet condenser, plain slide valves to both cylinders. propeller 6′ diam. 7½′ pitch. Towing from 20,000 to 30,000 logs in dead water, the wheel turns 120 revolutions per minute. Now then, I want a little more power: One opinion is to put on a wheel with less pitch to make engine turn 150 revolutions; the other to put in an intermediate cylinder, and keep on the same wheel. You are left to judge the matter, which I hope will not be imposing upon your generosity too much. Will 18″ be suitable size for the intermediate; the pressure on l.p. per gauge is 8 to 9 at present. If the additional cylinder is chosen, how fast ought the present wheel turn? When an engine turns, say 100, with a certain wheel, how do you determine by rule to make it turn, say 150? Please state by decreasing pitch, diameter, or both. Hoping this will be the means of somebody else learning something besides myself and engineers, I remain, etc., TUG.

Kippewa, Ont.

[What is desired is more engine power from the present boiler. The high pressure cylinder is 12½ ins. diameter, = 122.7 sq. ins. area; the low-pressure cylinder is 24 ins. diameter = 452 sq. ins. area; ratio, about 3.67 to 1. This should give 12 expansions of volume and yield up all the power of the steam in the cylinders. To do this the steam should follow a little over one-third of the stroke in each cylinder. The engine, according to the statement, is faulty in valve-arrangement, otherwise the pressure in receiver would not drop to 9 lbs. gauge-pressure (24 absolute) instead of 17 lbs. gauge-pressure, or 32 lbs. absolute. To get more power, re-set the valves to cut-off a little over one-third stroke in each cylinder, and be sure that the terminal pressure of the high-pressure cylinder is the initial of the low-pressure cylinder. It is good practice to decrease pitch of wheel to increase the revolutions, although, in some cases, the diameter may be reduced as well as the pitch. The pitch, in either case, must be reduced to increase revolutions. It is evident you will get more power by re-setting the valves, or rather re-arranging them. There is not pressure enough to use a third cylinder economically. It is presumed you have a link-motion expansion gear. Since you say the cylinders have plain slide-valves, it is easy for you to get the desired cut-off by the links.—EDS.]

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A FALSE REPORT.

Editors ENGINEER:

A paragraph has been going the rounds of the papers to the effect that the steam yacht '*Radha*' broke down off College Point lately and was towed to Bay Ridge, and stating that her four Roberts' boilers were defective and would have to be taken out. The statement is without foundation, as her boilers are a pronounced success, and are similar to those in use in Commodore Starbuck's yacht '*Tillie*.' The '*Radha*' was towed in on account of the blowing out of a gasket in the steam pipe, disabling the main engine temporarily.

The '*Radha*' made the run from Poughkeepsie dock to the Battery, against a strong flood tide, using only natural draught, in exactly four hours and fifty minutes. E. E. ROBERTS.

New York.

◆

IN MEMORIAM.

AT a regular meeting of M. E. B. A. No. 50, held at their rooms, 287 Hudson Street, New York, June 24, 1890, the following preamble and resolutions were adopted:

Whereas, Our Heavenly Father, in His infinite wisdom, has summoned from our ranks our esteemed friends and brothers ROBERT C. BAGGS and GEORGE E. GEARING,

Resolved, That we convey to the families and friends of our deceased brothers a sense of our bereavement, While yet in the morning of life and the height of their usefulness, they depart, leaving in the minds and hearts of the members of this association a shining reflection of their character as men, and zealous co-laborers in the cause in which we are enlisted, that time cannot efface.

To the stricken families do we offer our earnest sympathy and mingle our sorrow with theirs, in this hour of their deep affliction.

Resolved, That in memory of our departed brothers, we drape our charter and altar for a period of thirty days, these resolutions incorporated in our minutes, and a copy transmitted to the families our lamented brothers.

ANDREW. M. LESTER, President.
G. MARION WHITE.
JAMES H. SIPPERLY,
WILLIAM S. HOLTON,
Committee.

◆

KEEL CONDENSERS.

Editors ENGINEER:

Will you please explain the most approved form of "keel condensers," and also state the usual proportion of air pump to cylinder capacity?

How much cooling surface is generally allowed to the nominal horse-power?

An answer to the above would be greatly appreciated by JUNIOR.

Massachusetts.

[We are now publishing a compound launch engine, marked sizes, as made by the Bureau of Steam Engineering. This has an outboard. or keel condenser, which will be given in detail. Proportion of cooling surface is 1½ to 2 square feet per h.p. in ocean steamers.]

◆

BRO. J. H. MITTENDORFF, corresponding secretary of the M. E. B. A. No. 6, Baltimore, is now employed as draughtsman at the Ordnance Department, Washington, where he will be pleased to see all traveling brothers.

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IT is pleasant to read of the performances of snow plows in this weather.

THE ENGINEER.

FORTNIGHTLY. · · $2.00 PER ANNUM.
Foreign Subscriptions, · · · · · · 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

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VOL. XX. NEW YORK, JULY 5, 1890. No. 1.

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SUCCESS IN TRADE.

MANY large and small concerns all over the country are carrying on business to keep their men in work. This not by reason of any stringency in orders or slackness in trade, but solely because of their methods. In other words, they do business at a loss the year round. There is, if one may use such a term, an intuitive perception in all good managers which amounts to almost a sixth sense. Through the possession of this faculty they can tell very nearly whether any given order carries a profit before it is put in hand, and they will not take it unless it does pay them to do so; but there are others who will, who also know that the order is an actual loss, but accept it, and even solicit it. One or two such in a large line of work do not seriously dilute profits, but a run of orders of the class mentioned means simply working for the men. If the shop is an individual concern, the proprietor thereof is in a very unhappy state of mind naturally. If it is a corporate concern the stockholders have long faces, harass the president, and howl for dividends, which they never receive.

Now all this unpleasantness to every one is quite unnecessary. A business which does not pay a fair profit to its conductors is no business at all, and may succumb at any moment. Its status is very well known indeed to all business men; for whether a concern makes or loses, it is known to all. It cannot be hidden. It arises solely from a want of firmness on the part of the principals in obtaining profitable prices for their work, and refusing work if it does not pay them to take it. Where it is taken at a loss it amounts to paying the buyer a premium for his order, or giving him the profit which the maker of the goods should have. Some weak brother says, possibly, that if they did not take orders at going prices they would not get any, and might as well shut up the shop; to which the only rejoinder which can be made is that if the concern our weak brother represents cannot make money at going prices for his class of work, there is something wrong in his management, and if he does not find out where the trouble lies, the shop will not wait to be shut up, but will shut itself up.

There have been treatises written on "How to Succeed in Business," and interviews have been published in papers to the same end; but these, one and all, are not worth the paper and ink expended on them, as guides to others. Success in trade depends upon the temperament, moral and physical, of the leaders, and one might as well write a treatise on how to carry on household affairs as upon how to conduct business successfully. Promptness, firmness, courtesy under all circumstances, honesty in every transaction, bearing one's own losses, not endeavoring to saddle others with them—these are cardinal points. Clad with unfaltering courage and determination to succeed or go down with the ship, they ought to set any concern firmly on its feet.

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PASSING COMMENT.

WE observe that a writer in a contemporary is amusing himself by a series of articles entitled *"Force, Power and Work."* There is no question but that the attempt is an ambitious one, or a praiseworthy one, whether this particular series is a useful one depends wholly upon the light in which we look at the matter. It is, perhaps, proper to remark that there is not and cannot be any new gospel of mechanics with our present knowledge of nature. The old laws are still valid, and have been tolerably well explained, lectured upon, illustrated, and popularly treated by such writers as Reuleaux, Zeuner, Rankine, et al. Just why a lesser light should set himself the task of doing all their work over again, in the belief that he can do it better, it is hard to see. When a man can render clearer that which is obscure, or add something to the common stock of knowledge; when he can give a plausible verdict on a moot point, he is a benefactor to whom we render thanks for his aid, but when a man who is or is not capable cheerfully points out to us that the source of sunshine is the sun, that the function of wind is to create currents, that the moon exerts an influence upon the waters of the earth, that the atmosphere is luminous, and similar elementary truths, we do not feel greatly indebted to him for publishing these things in a trade paper, but do feel like advising him to confine himself to writing works on the elements of philosophy for the use of primary schools.

Sometimes men tell us things that we have long outgrown in such a charming way that we gladly read them, because of the fluent style in which they are written. Words take on a new meaning, and sentences fairly scintillate with the brilliancy of the diction. Such writers we all admire, and give them our attention solely for their literary talent. But we do not care greatly to have Dr. Dryasdust smother us with his trite observations, clothed in such slovenly phrases that we nod and drop off to sleep in utter weariness. We feel like advising the worthy doctor to take a vacation and let us all have a rest from his prosing.

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MISSION OF THE TRADE PAPER.

THERE are many alleged trade papers published in this country whose mission appears to be to boom wild cat schemes in mechanics and engineering, and induce persons to invest their money in worthless ideas, which have not the shadow of a chance of success. The conductors of such papers do not intend to deceive their readers or delude them into investing in motors of this or that kind of machine which is to obtain power for nothing, but they, nevertheless, give publicity to them, and this is just what the promoters of such schemes want. The editors of alleged trade papers are ignorant of the first principles of engineering or mechanics, but they print all they hear, regardless of whether it is practicable or not. The mischief of this lies in the fact that there are many simple-minded persons who have money to invest that believe everything they see in print to be in good faith, and they make haste to buy the stock of the *Submarine Windmill and Seaweed Digging Company*, before it is all taken up.

Conductors of trade papers should protect their readers against wild cat schemes in mechanics and engineering, and warn them against the folly of trusting their money to people who claim to get power for nothing. If they did there would be fewer such schemes exploited yearly.

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OBEYING ORDERS.

TWIN brother to the man who cannot understand a plain drawing is the one who knows better than you do what you need. It is not long ago that we gave an order for a certain article in person, which the man who took the order said he fully understood. When it was received it was entirely different from the order. Demanding an explanation, we were told that our way was not the regulation way, and they thought it better to make the article as they always had made them.

We thought it better to refuse the goods entirely, and demand that the order be filled as it was given, which made the smart foreman, who was the offender, very sour indeed.

There are a class of men in trade who ought to go to sea for a while to learn what obeying orders means. Nothing short of the soft end of a capstan bar will teach them that their mission on earth is filled when they do as they are told, that an order is an order if it spoils the job or scuttles the ship, and that their sole duty is to do what they are told without any ifs, ands, or buts. Men who cannot do this are clearly unfit for responsible places, for the first lesson in governing others is to learn how to obey orders ourselves.

THE NEW NAVY.

NOT so many years ago we protested against the purchase of foreign plans for American war vessels, asserting that our own engineers and naval constructors had no superiors in the world, and if they were given a chance would demonstrate their ability to compete with foreign engineers and excel them. How correct our assertions were is shown by the success of the '*Chicago*' and the '*Philadelphia,*' U. S. N. The former the London *Engineer* declared unfit for sea by reason of her brick furnaces, but she has kept the sea for over six months, and the brick furnaces are in her yet. The engines of the '*Chicago*' are of the beam type, and exclusively American. We have heard no evil reports from them. The '*Philadelphia*' is a sister ship to the '*Baltimore,*' which last was built on foreign plans. With less engine power she has achieved higher speed, and in other essentials proven a superior vessel. Mr. Horace See, formerly superintending engineer with the Cramps, where the '*Philadelphia*' was designed, should receive the credit of this performance.

The '*San Francisco,*' the first of the new vessels whose machinery is entirely of the Bureau of Steam Engineering design, directed by Chief Engineer Melville, is to be tried in a few days, and there is no reason to doubt but that she will be a success from the start. The hull was designed by Chief Naval Constructor Wilson, and her general dimensions are the same as those of the '*Philadelphia.*" The three cylinders, of 42, 60, and 94 inches diameter respectively, are the same size as those of the '*Baltimore.*' The stroke is 36 inches, the propeller 14¼ feet in diameter, the crank shaft 14¼ inches, and total length of journals 114 inches. The crank pin is 15 by 16 inches, and the four double-ended boilers are each 14½ feet in diameter by 19 2-12 feet long. The grate surface is 560 square feet, with a heating surface of 19,500 square feet more than that of the '*Baltimore,*' and nearly as much as that of the '*Philadelphia.*' The weight of the '*San Francisco's*' machinery and water is 850 tons.

The *Times* says that the new 7,300 ton cruiser's dimensions have not yet been definitely fixed, but she is to have great length and fine lines. She will have her machinery and boilers under a heavy protection deck, and light side armor in addition, so that it will take a heavy shot to disable her.

The most interesting feature, however, will be her machinery. She is to have three screws, driven by three triple-expansion engines, placed in three separate water-tight compartments. The combined horsepower will be over 20,500, and will drive her through the water when working under forced draught at the rate of over twenty-two knots an hour, enabling her to overtake and capture the '*City of Paris*' or any other of the great ocean racers. She will be able to steam at twenty-one knots an hour across the ocean and back again without a stop if necessary. For ordinary cruising, at economical speed, she will usually use her two side screws, and will make about eighteen knots per hour. With her center screw, working as a single-screw vessel, she will make fifteen knots per hour.

The machinery is now being designed, and will embrace the latest improvements. The use of three screws has been adopted in the Italian Navy for nine torpedo cruisers, and in the French Navy on the '*Dupuy-de-Lome,*' a light-armored cruiser about 1,000 tons smaller than the proposed vessel. The French adopted the idea after extensive experiments with a steam launch called the '*Carpe,*' built for the purpose. Naval Constructor Philip Hichborn witnessed some of these experiments, and, in his report on European dockyards, called attention to them. He was led to think very highly of the innovation from his observations and his conversations with French naval officers.

In the new cruiser a number of improvements over the '*Dupuy-de-Lome*' will be made. In the French vessel the three screws are very nearly in the same horizontal plane, the side screws occupying the usual places of twin screws and the center screw being further aft and slightly lower, occupying the usual position of a single screw. The relative position of the screws is such that the center screw must work almost altogether in the broken water thrown back by the two side screws, with consequent loss of power. In the new cruiser the center shaft will incline downward so as to bring the screw well down below the plane of the side screws, and the side screws will be splayed outward slightly, so as to throw the water away from the center screw. [What will it work on then?]

The engines driving the side screws will be side by side, with a longitudinal water-tight bulkhead separating them. The center engine will be abaft these, on the keel line, and separated from them by a transverse water-tight bulkhead. All the engines will be vertical, which is an improvement on the '*Dupuy-de-Lome,*' where, owing to her smaller size, there was not room below the protection deck for vertical engines at the sides, and they were made horizontal. Steam for the driving engines will be furnished from eight double-ended boilers in four water-tight compartments. Six of these boilers will be 21 feet 3 inches by 15 feet 6 inches, and two will be 21 feet 3 inches by 14 feet. In addition there will be two donkey boilers on the spar deck to furnish steam for the auxiliary engines and the pumps.

LATEST LEGAL DECISIONS ON TRADE.

REPORTED FOR THE ENGINEER.

[WE shall until further notice publish the latest decisions in courts of last resort upon topics of general interest to our readers. From these decisions they will be able to judge in a measure of their own chances in similar cases.]

Depositing Refuse in Harbor.—The act of Congress prohibiting the discharge of refuse " in the tidal waters of the harbor of New York, or its adjacent or tributary waters," does not give the supervisor of New York control over that part of the Hudson River in the vicinity of Newburg.—*United States* v. *The Sadie, District Court of the United States, Southern District of New York,* 41 *Fed. Rep.* 832.

Negligence of Employer as to Condition of Engine.—In an action for personal injury caused by the blowing out of the cylinder-head of an engine, evidence that the employer knew, or had a right to know, that there was a crack in the piston which had existed for some time, is relevant; it may also be taken into consideration that the one who is injured while acting as an engineer, though not a skillful engineer, intended to become one and follow the business permanently. Impaired capacity to labor and follow a business or vocation is a proper element for damages in cases like this.—*Howard Oil Co.* v. *Davis, Supreme Court of Texas,* 13 *S. W. Rep.* 665.

The Stranding of a Vessel to Save Her.—A vessel which was going in a fog at a high rate of speed was stranded because the master changed her course two minutes before the vessel reached the proper place for turning, he supposing she had reached such point. A few minutes after, a storm coming up, the vessel was scuttled to save her. In an action on a marine insurance policy for damage to the cargo and vessel, the court found the proximate cause of the loss arising from such scuttling is the storm, and not the stranding.—*Northwest Transportation Co.,* v. *Boston Marine Ins. Co. Circuit Court of the United States, Eastern District of Michigan,* 41 *Fed. Rep.* 783.

Shipping—Charter Party—Cancellation—Readiness to Load.—A charter party provided that the vessel chartered should, " with all convenient speed, sail and proceed " to certain ports, and there load a certain cargo, " and, having so loaded, proceed direct under steam to Liverpool. * * * The entire carrying capacity, including cross-bunkers, space under bridge deck, lazarette, deckhouses, and other spaces where steamer has usually carried cargo, or would carry cargo if loaded on rates, shall be placed at the disposal of charterers, exclusive of any space which may be needed for the crew, cabin stores, and coal for the voyage. * * * If no heavy cargo be shipped, and additional ballast be required, the same to be provided by the steamer." It also provided that the charter should not commence " until the morning after the steamer is ready to receive cargo at the place of loading, all of her holds being cleared and passed for grain, and customary notice given thereof to the charterers or their agent; and such notice must be given before twelve o'clock of the day that the steamer is ready. * * * Should the steamer not be ready in all respects for cargo, at her first loading port for entering on this charter, by December 25, 1888, the charterers may cancel the charter." Under this charter the vessel arrived at one of the loading ports and gave notice of readiness on Saturday, December 22, after 12 o'clock, which the charterers declined to receive. The notice was repeated on Monday, the 24th, before 12. At the time of this last notice she had not cleared, and passed to the disposal of the charterers, a space of 4,268 cubic feet, called the " main 'tween-decks," or cross-bunkers, claiming it was necessary for the coal, which the charterers denied. She had no ballast either aboard or accessible, and could get none by her cancellation date. She had not been passed for grain, and one of her holds was wet from a leakage, so that grain could not have been put there without additional preparation. She had not coaled for the voyage, and the charterers were justified in cancelling the charter on the ground that her notice of readiness was untrue at the time it was given.—*Urow* v. *Meyers, District Court of the United States, Eastern District of Virginia,* 41 *Fed. Rep.* 806.

Collision—Steam Vessel and Tow.—As a steam yacht passed out from her anchorage under hard-a-port wheel, a steam tug was observed on her port bow, about 800 feet distant. By signal, it was agreed that the yacht should pass astern, while the tug kept her course, and the yacht's wheel was put to starboard, and she continued without slackening speed until almost under the tug's stern, between her and her tow, which was connected with her by a hawser, and which was then first observed by the yacht, whose engines were then reversed, but the tow collided with her. The yacht had no forward lookout. The yacht was in fault for not having a lookout, for not sooner seeing the tow, and for not slackening speed. After the agreement by signal, it was not negligence in the tug to continue without change of course, though the yacht would otherwise have had the right of way, and the tug had the right to presume that the yacht would observe the tow.—*Stetson* v. *The Gladiator, District Court of the United States, District of Massachusetts,* 41 *Feb. Rep.* 927.

Negligence as to Size of Rope.—Where one is injured on board a vessel by the breaking of a rope in an action to recover for such injuries, the injured party claimed it was three inches, and the defendant four inches; the use of the smaller size would have been negligence, and a judgment in favor of the plaintiff will not be received.—*Nikkelsen* v. *Ocean and Inland Transportation Co., City Court of Brooklyn,* 9 *N. Y. Supp.* 741.

Damages for Breach of Personal Services Contract.—Where a person enters into a definite contract to render to another, and to no one else, personal services of such a nature that their loss to the employer and acquisition by another would cause injury not to be compensated for in damages, a breach of the contract in leaving the employer and contracting with a rival may be restrained by injunction.—*Metropolitan Exhibition Co.* v. *Ward, Supreme Court of New York,* 9 *N. Y., Supp.* 779.

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NOWADAYS stock companies are boomed by advertising ostentatiously that no stock is for sale. That makes everyone want it.

Foreign and Domestic Trade Literature.

THE ADAPTATION OF THE STEAM MACHINERY IN MARINE CONSTRUCTION. No. 2.

By Chas. E. Emery, Ph. D., N. Y. City.

It by no means follows that because triple-compound engines are more economical in fuel that they are the best to use in every case, or would prove the most economical when all the conditions of the problem were taken into consideration. Where fuel is cheap or labor is dear, particularly where both conditions obtain at the same time, the simplest type of machinery is not only the best, but the cheapest in the long run, as the interest on the higher priced machinery must be considered.

In light boats on the Western rivers, machinery involving even a trifle more weight, either in the engines themselves or any adjunct thereof, is not allowable. In some of these rivers the vessel, as a whole, is liable to destruction, so cheapness as well as lightness is secured as much as possible. The same principles apply on the seaboard. A coaster cannot afford to save even $2 a day on fuel and pay out the same, or a greater quantity, for the wages of more experienced employees, or for the repairs to a more expensive type of machinery. Again, the interest account frequently makes it unadvisable to increase the expense of machinery, either in the merchant or government services, for the reason that the vessels lie idle to load in the one case, and wait very much of the time for emergencies or periods of duty to arrive in the other. A small government vessel running on the average three, or even as much as eight or ten hours a day, and lying under banked fires for the rest of the time, will waste the same fuel in keeping the fires alive, whether the engines be of high economy or low, and this consideration, together with interest on first cost, extra attention and repairs, rapidly balances the gains, which affect simply the saving of fuel.

Coasting vessels, making cruises of two or three days' duration, and lying idle for the same time, can afford greater original expense, but not to a serious extent, as the economical management of such vessels requires that the number of the crew be kept down to the lowest possible limit, requiring hard work at sea, but giving more liberty when in port.

What may be called commercial considerations are really the governing ones in the selection of the type of machinery, and cannot permanently be ignored merely to secure economy in any one of the many directions in which money is expended in marine construction. In vessels crossing the sea, where the quantity of coal consumed is such an important proportion of the carrying capacity of the ship, and the cost of fuel, moreover, has an important bearing on the balance sheet, showing the profits of the voyage, it is necessary to select machinery of the highest economical type consistent with positive certainty and continuity of action.

The considerations leading to a decision of the question as to the proper type of machinery, are: 1st. The kind of machinery which has proved serviceable already in that particular service. 2d. The success of innovations that are made in every service, and the causes of failure. And, 3d, the success of different types in different parts of the country or different parts of the world, where the duty is very much like that which is being studied.

On these premises, it may be judged exactly what innovations will probably be successful, and the adaptations made on that basis. The question whether sidewheels or screw propellers should be employed sometimes occurs, but not so frequently as in former years. The propeller engines, with their higher speed, are so much more compact and weigh so little in comparison with sidewheel machinery, that they are usually employed wherever it is practicable.

The latest improvements permit the economical use of screw propellers, even with vessels drawing as little as two feet of water, but their use is exceptional, as the light draught steamers, with small feathering paddle wheels, used abroad, are very well adapted for the work, and can be built in this country for such duty with advantage. There are, however, cases where screw propellers are entirely feasible that sidewheels are used simply to obtain steadiness. In designing the machinery for the U. S. revenue steamers, the writer at first put in quite a number of compound engines; then finding, in making the experiments, now so well known, with the *'Rush,' 'Dexter,' 'Dallas,'* and *'Gallatin,'* that very nearly the same results could be obtained with single engines using high steam pressures, by keeping the cylinders smaller than customary, so as not to attempt to get too much expansion, this type of engine was used for further construction for a time. When Congress became more liberal and made larger appropriations, it became desirable to obtain increased speed for the steamers. So compound engines were again resorted to to obtain more power, and were run at higher speeds than formerly, particularly when connected to twin screws.

Table of Time Allowances for Steam Yachts of the American Yacht Club, Based on the Rule Submitted by Chas. E. Emery, Ph.D., that the Speed of a Yacht in Knots per Hour Should Equal Two and Seven-tenths Times the Cube Root of the Length of the Yacht in Feet on the Load Water Line.

Length in Feet at Load Water Line.	Speed in Knots per Hour.	Time Allowed to Run 80 Knots.			
		Hours.	H.	M.	S.
50	9.947	8.0424	8	02	33
60	10.571	7.5672	7	33	42
70	11.127	7.1896	7	10	57
80	11.634	6.8760	6	51	49
90	12.099	6.6120	6	36	42
100	12.533	6.3832	6	23	01
110	12.936	6.1840	6	11	02
120	13.316	6.000	6	00	25
130	13.678	5.8488	5	50	55
140	14.018	5.7072	5	42	15
150	14.345	5.5768	5	34	36
160	14.658	5.4576	5	27	27
170	14.958	5.3480	5	20	53
180	15.244	5.2480	5	14	53
190	15.522	5.1538	5	09	14
200	15.790	5.0664	5	03	59
210	16.049	4.9848	4	59	05
220	16.300	4.9080	4	54	29
230	16.543	4.8360	4	50	10
240	16.778	4.7680	4	46	05
250	17.010	4.7032	4	42	12
260	17.234	4.6424	4	38	33
270	17.450	4.5848	4	35	05
280	17.663	4.5296	4	31	47
290	17.871	4.4768	4	28	36
300	18.074	4.4264	4	25	35

The weight has an important bearing on the selection of machinery for a vessel. It will be readily understood that a certain power can be obtained with a certain steam pressure and certain degree of expansion, with a certain fixed piston development. This development may be obtained with a large engine running slowly, and the same may have a large piston and short stroke, or small piston and long stroke, or cylinders of smaller capacity can be used, and the engine required to make more revolutions.

The high horse-power secured in torpedo boats is obtained with small engines running at high speeds of revolution. For instance, a compound engine with a large cylinder 21 inches in diameter, with only 12 inches stroke, has been run regularly 438 revolutions per minute and furnished 460 i.h.p. The ordinary type of engine for 460 h.p. in the merchant service would have a cylinder 36 to 42 inches in piameter and about 42 inches stroke, and be run at a speed of 65 to 80 per minute, according to the steam pressure and actual sizes employed. The weight of the engine last named would be about seven times as great as that of the first. The question arises at once, why not use torpedo boat practice in all cases? Simply for the reason that it is not desirable to strain up to the highest working point continuously any form of mechanism, any more than our own physical and mental faculties. The torpedo boat practice represents all that is possible to get out of a given mass of material. At such high speeds, the least neglect of the oiler will cause the brasses and bearings to be cut, and very slight mishaps culminate in permanent injury to the machinery, requiring its disuse until repairs can be made. Such work is a necessity in torpedo practice, but the difficulty of obtaining in regular practice the results which the contractor is obliged to guarantee, is shown by the fact that so many torpedo boats break down during seasons of practice when handled by such naval crews as can be obtained for the purpose.

The vessel is practically built of sheet iron, riveted together cold, and the weight of all parts cut down to a minimum. The general strength of the structure can be best understood by explaining that a particular vessel, in making a landing with the writer and others on board, touched the dock very lightly, but, as it proved, with sufficient force to crush in the side of the vessel, showing conclusively that such a vessel would not be fit for a boarding cutter, which has to run up to a moving steamer at full speed. These facts should be fully understood by those who compare the government vessels, which have to do this rough duty, with the mere shells which have nothing to do but rush up with projectiles and get away as best they can. Evidently in ordinary practice a different type of machinery must be employed, though the introduction of the torpedo boat system has had the effect to modify modern construction so as to obtain some of the advantages of high speed and reduced weight.

In this connection we present as a matter of interest a table extracted principally from a paper of Chief Engineer Sennett, of the English navy, illustrating from the vessels of that navy the effect of the various improvements in the machinery of steamers since the advent of steam navigation. In 1832, with side-lever paddle-wheel engines, flue boilers carrying only 4 lbs. of steam, and jet condensers, there was only 1.45 i.h.p. obtained per ton of weight. Tubular boilers and 9 lbs. pressure increased the power to 3.14 i.h.p. per ton in 1845; oscillating engines and 14 lbs. of steam, to 4.72 i.h.p. per ton in 1850; screw engines and 20 lbs. of steam, to 5.52 i.h.p. in 1857; and the surface condenser and 30 lbs. of steam, to 7.5 i.h.p. per ton in 1870. The compound engine, with 60lbs. of steam, only obtained 6.4 i.h.p. per ton in 1876, but, of course, greatly reduced the total weight carried, on account of reduced coal consumption. Triple compound engines, on the whole, only produce a saving in fuel, rather than of weight, to be carried. The increase of weight due to compound and triple compound engines is chiefly caused by the heavier boilers required for the higher pressures, though the engines are generally somewhat heavier. The introduction of forced blast has, however, enabled the weight of the boiler to be reduced, and high speeds, as previously referred to, reduces the weight of the engine so, as shown, the torpedo boat machinery developed in 1880 gave 37.66 i.h.p. per ton of weight, and in a fast steamer built in 1882, as a compromise between the ordinary and torpedo boat types of machinery, 12.56 i.h.p. was obtained per ton of weight. Steam pinnaces are now in regular use in the British navy with machinery patterned after that of the torpedo boats, which furnish 22.2 i.h.p. per ton of weight. Boats of superior speed of this class were first built in this country by Herreshoff, of Bristol, R. I.

It is interesting in the table to observe the progressive increase of steam pressure, of revolutions, of the i.h.p., and, to some extent, of the mean pressure per ton of weight, in connection with the decrease in the several items of weight.

The economy of triple compound engines, compared with that of compound engines of

Relative Weights of Steam Machinery of Different Types.

	Date.	Type.				Number of Engine	Diam. of Cylinders.		Stroke of Pistons		Steam Pressure.	Mean Pres. ref'rr'd to large Cyl.	Rev. per Minute	I.H.P.	Weight per I.H.P.				I.H.P. per ton of Wght.
		Engine.	Boiler.	Propeller.	Condenser.		Small.	Large.							Engines.	Propellers and Shafting.	Boilers and Water	Total.	
							Inches.	Inches.	Ft.	In.	Lbs.	Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	
British Naval Steamers.	1832	Side Lever	Flue	Padddle	Jet	2		55½	5	0	4	15.6	17.5	400				1,550	1.45
	1845	Vertical	Tubular	"	"	4		72	8	0	9	16.0	15.0	1,905	272	136	306	714	3.14
	1850	Oscillating	"	"	"	2		72	7	0	14	18.3	20.5	1,300	164	70	240	474	4.72
	1857	Trunk	"	Screw	"	2		82	4	0	20	21.8	54.0	3,005	106	45	254	405	5.52
	1870	Horizontal	"	"	Surface	4		72	3	0	30	24.5	73.9	5,384	127	30	140	297	7.50
	1876	Vert. Com.	"	"	"	2	70	114	3	10	60	20.9	78.8	7,696	124	33	193	350	6.40
	1882	Horiz. "	Locomotive	"	"	2	38	64	3	3	120	36.2	120.0	5,500	75	18	85	178	12.56
	1880	Vert. "	"	"	"	1	12¾	20⅞	1	0	120	50.2	438.0	460	20.7	3.65	35.3	59.65	37.66
U. S. Steamers.	Charleston 1889	Inclined Compound	Locomotive Cylindrical	Twin Screw	"	2	44	85	3	0	90	27.4	116.3	6,943	236.2		107.4	343.6	6.52
	Baltimore 1889	Triple Compound	Cylindrical Tubular	"	"	2	42 60	94	3	6	135	26.2	120.6	9,549	231.4		115.1	346.5	6.43

best construction, has not until recently been satisfactorily determined. It has been shown that vessels with triple compound machinery ran more economically than the old compound engines, but the published comparisons were made with the latter when run down after years of constant use. In a paper by the writer on "The Development of the Compound Engine," etc., Trans. Am. Soc. M. E., vol. viii, the writer deduced from actual experiments with the compound engine of the '*Rush*,' that, if the pressure were doubled, so that two more expansions were secured in another cylinder, the power should be obtained for 15.15 lbs. of feed water per i.h.p. per hour, and this is practically the result shown, we are informed, by recent experiments, the report of which has not yet been examined. Leaving the special consideration of the weights in detail till the subject comes up in the order first named, we will proceed to the general considerations necessary in fixing the type of boiler, and then discuss the manner of determining its general dimensions for a particular case. Boilers with flues or large tubes may be considered a thing of the past, except for use in very muddy water, with highly bituminous coal—a condition that exists on our western rivers. The high pressures now required reduce the number of what are called tubular boilers available down to a few general types. In the form most commonly used, known frequently as the Scotch type, tubes are arranged over circular furnaces in cylindrical shells, requiring but little bracing. The weight of water in these boilers is, however, large, so the ordinary locomotive type, with tubes arranged in a continuation of the furnaces, has generally been adopted for torpedo vessels.

A form resembling our land boilers, in which the furnace is located below the circular shell and return tubes inside it, has been used to some extent in this country, and it is believed could be more generally employed with advantage. Several attempts have also been made to use water tubular boilers, in which all the water is contained in small sections, thereby reducing the weight of water carried and increasing the safety, the general type being known as "sectional boilers." No sectional boiler of this kind has as yet been sufficiently successful to warrant its adoption. Many engineers do not yet feel warranted in constructing boilers with the furnace under the shell, and the locomotive type is expensive in construction and repairs, so that the cylindrical type first named is more generally used, and we will proceed to examine in detail the steps which may be employed in fixing the dimensions of a boiler of this type. In the previous lecture, on the "governing proportions of steam boilers," attention was called to the fact that the power of the boiler being principally limited by its power to burn coal, the proportion which under ordinary circumstances most affects the capacity is the cross area of the tubes for draught, always presupposing that the grate is of ample size and the smoke pipe of ample height to produce the draught. Calculations may be made ascertaining the intensity of the draught which will be secured with a smoke pipe of given height when the joint resistances of the tubes, connections and grate are considered, but ordinarily it is quite sufficient to know the quantity of coal which can be burned per square foot of grate with the draught available in steamers of the same class. In the naval vessel used during the war, with smoke pipes sixty feet high above the grates, it was considered that sixteen pounds of coal per square foot of grate could be burned with natural draught, and in the merchant service it is safe to estimate about the same rate. With smaller steamers and smoke pipes barely forty feet high above grates, fourteen pounds per square foot of grate is nearer the maximum for natural draught. If the grate be eight times the cross area of the tubes for draught, the quantity of coal consumed per square foot of cross area of tubes for draught would, on this basis, be 112 pounds. The average performance for regular duty is always less than the maximum; so it has been the practice of the writer, in designing small steamers without artificial draught, to consider that there would be only 100 pounds of coal burned per square foot of cross area of tubes; and this has been used rather than the consumption per square foot of grate surface, for the reason that it is a more correct index of power on account of the different proportions of grate to cross area. If a large proportion of grate be provided, the resistances through the grate are reduced; but with a greater proportional cross area of tubes the head to draw the air through the grate is increased, so that a larger quantity of coal can be burned per square foot of grate, and within the limits, say of 7½ to 8½ of grate to one of draught area, the quantity of coal burned will be proportioned nearly to the draught area, but when the grate is proportionally smaller it should be considered in connection with the draught area.

(*To be continued.*)

Another queer optic complication was that of a person who was short-sighted in one eye and long-sighted in the other. Both defects were very slight at first, so that not much inconvenience was felt. But after a while this inconvenience increased, and he who suffered from it resorted to ordinary spectacles. They didn't do him any good, and he went to an oculist. That scientist made an examination and wrote a prescription, and pretty soon the patient was contemplating the objects of life as they really are, through a pair of glasses made up of one concave and one convex lens. His was a somewhat rare case, too. There are a number of human beings in the world who rejoice individually in the possession of one good eye and one bad eye. Either the "off" eye is long-sighted or short-sighted, or otherwise defective. In such cases one piece of plain glass is used, and the other part of the spectacles is a lens made to fit the complaint. Such persons are born wearers of the British monocle.

LIGHTNING CONDUCTORS, FROM A MODERN POINT OF VIEW.

By Prof. Oliver J. Lodge.

A lightning conductor used to be regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea was that a certain quantity of electricity had to get to the ground somehow; that if an easy channel were opened for it the journey could be taken quietly and safely, but that if obstruction were opposed to it violence and damage would result. This being the notion of what was required, a stout copper rod, a wide-branching and deep-reaching system of roots to disperse the charge as fast as the rod conveyed it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, were the natural guarantees of complete security for everything overshadowed by it. Carrying out the rain-water-pipe analogue, it was natural also to urge that all masses of metal about the building should be connected to the conductor, so as to be electrically drained to earth by it, and it was also natural to insist on very carefully executed joints, and on a system of testing resistance of conductor and "earth" so as to keep it as low as possible. If ever the resistance rose to 100 ohms it was to be considered dangerous.

The problem thus seemed an easy one, needing nothing but good workmanship and common sense to make accidents impossible. Accordingly, when, in spite of all precautions, accidents still occurred, when it was found that from the best-constructed conductors flashes were apt to spit off in a senseless manner to gun-barrels and bell-ropes and wire fences and water butts, it was the custom to more or less ridicule and condemn either the proprietor of the conductor, or its erector, or both; and to hint that if only something different had been done—say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall, or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earth-plate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet, or etc., etc.—then the damage would not have happened. Everyone of these excuses have been appealed to as an explanation of a failure; but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

All this is now changing or changed. Attention is now directed, not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between. It is recognized that all this volume of energy has somehow to be dissipated, and that to do it suddenly may be by no means the safest way. Given a store of chemical energy in an illicit nitro-glycerine factory, it could be dissipated in an instant by the blow of a hammer, but a sane person would prefer to cart it away piecemeal and set it on fire in a more leisurely and less impulsive manner. So also with the electrical energy beneath a thundercloud. A rod of copper an inch or a foot thick may be too heroic a method of dealing with it; for we must remember that an electric discharge, like the recoil of a spring or the swing of a pendulum, is very apt to overshoot itself, and is by no means likely to exhaust itself in a single swing. The hastily discharged cloud, at first, suppose, positive, over-discharges itself and becomes negative; this again discharges and over-discharges till it is positive as at first and so on with gradually diminishing amplitude of swing, all executed in an extraordinarily minute fraction of a second, but with a vigor and wave-producing energy which are astonishing. For these great electrical surgings, occurring in a medium endowed with the properties of the ether, are not limited to the rod or ostensible conduit; the disturbance spreads in all directions with the speed of light, and every conducting body in the neighborhood, whether joined to the conductor or not, experiences induced electrical surgings to what may easily be a dangerous extent. For not only is there imminent danger of flashes spitting off from such bodies for no obvious reason—splashes which, on the drain-pipe theory, are absolutely incredible—flashes sometimes from a perfectly insulated, sometimes from a perfectly earthed piece of metal; but, besides this, remember that near any considerable assemblage of modern dwellings there exists an extensive metallic ramification in the gas-pipes, that these are in places eminently fusible, and that the substance they contain is readily combustible.

On the drain-pipe theory, the gas-pipes being perfectly earthed, would be regarded as entirely safe so long as they were able to convey the current flowing along them without melting; but, on the modern theory, gas pipes constitute a widely spreading system of conductors able to propagate disturbance underground to considerable distances, and very liable to have some weak and inflammable spot at places where they are crossed by bell wire or water-pipes, or any other metallic ramification.

Above ground we have electrical waves transmitted by the ether, and exciting surging throughout a neighborhood by inductive resonance. Below ground we have electrical pulses conveyed along conductors, leaking to earth as they go, but retaining energy sufficient to ignite gas whenever conditions are favorable at considerable distances.

The problem of protection, therefore, ceases to be an easy one, and violent flashes are to be dreaded, no matter how good the conducting path open to them. In fact, the very ease of the conducting path, by prolonging the period of dissipation of energy, tends to assist the violence of the dangerous oscillations. The drain-pipe theory, and the practical aphorisms to which it has given rise, would serve well enough if lightning were a fairly long continued current of millions of amperes urged by a few hundred volts, or if there were no such thing as electro-magnetic inertia; but, seeing that the inverse proportion between amperes and volts better corresponds to fact, and seeing that the existence of electro-magnetic inertia is emphasized by multitudes of familiar experiments, the drain-pipe theory breaks down hopelessly, and only a few of its aphorisms manage to survive it.

What, then, are we to set up in place of this shattered idol? First of all we can recognize, what was virtually suggested by Clerk Maxwell, that the inside of any given enclosure, such as a powder magazine or dynamite factory, can, if desired, be absolutely protected from internal sparking by enclosing it in a metallic cage or sheath, through which no conductor of any kind is allowed to pass without being thoroughly connected to it. The clear recognition of the exact, and not approximate, truth of this statement, is a decided step in advance, and ought to be satisfactory to those who have to superintend the practical protection of places sufficiently dangerous or otherwise important to make the aiming at absolute security worth while. Similarly, for wire-covered ocean cables absolute protection is possible. But not for ordinary buildings, any more than for ordinary land telegraph offices, is such a plan likely to be adopted in its entirety. Some approximation to the cage system can be applied to ordinary buildings in the form of wires along all its prominent portions; and such a plan I have suggested, and I understand it is being carried out, for the entrance towers and part of the main body of the present Edinburgh Electrical Exhibition. For chimneys a set of four galvanized iron wires, joined by hoops at occasional intervals, and each provided with a fair earth, seems a satisfactory method; but it is to be noted that a column of hot air constitutes a surprisingly easy path, and that it is well to intercept a flash on its way down the gases of a chimney by a copper hoop or pair of hoops over its mouth. For ordinary houses, a wire down each corner and along the gables is as much as can be expected. At many places even this will not be done; a couple of vertical wires from the highest chimney stacks on opposite sides must be held better than nothing or than only one.

Earths will be made, but probably they will be simple ones, entailing no great expense. A deep damp hole for each conductor, with the wire led into it and twisted round an old harrow or a load of coke, may be held sufficient. And as to terminals: rudely sharpened projections, as numerous as is liked, may be arranged along ridges and chimney stacks; but I have at present no great faith in the effective discharging power of a few points, and should not be disposed to urge any considerable expense in erecting or maintaining them. Crowns of points on chimneys and steeples are certainly desirable, to ward off, as far as they can, the chance of a discharge, but a multitude of rude iron ones will be more effective than a few highly sharpened platinum cones. I find that points do not discharge much till they begin to fizz and audibly spit; and when the tension is high enough for this, blunt and rough terminals are nearly as efficient as the finest needle points. The latter, indeed, begin to act at comparatively low potentials, but the amount of electricity they can get rid of at such potentials is surprisingly trivial, and of no moment whatever when dealing with a thundercloud.

But the main change I look for in the direction of cheapness and greater universality of protection is in the size and material of the conducting rod itself. No longer will it be thought necessary to use a great thick conductor of inappreciable resistance; it will be perceived that very moderate thickness suffices to prevent fusion by simple current strength, and that excessive conducting power is useless.

In the days when the laws of common "divided circuits" were supposed to govern these matters, the lightning rod had to be of highly conducting copper, and of such dimensions that no other path to earth could hope to compete against it. But now it is known that low resistance is no particular advantage; it is not a question of resistance. The path of a flash is a question of impedance, and the impedance of a conductor to these sudden rushes depends very little on cross section and scarcely at all on material. A thin iron wire is nearly as good as a thick copper rod, and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy, and tends to damp out the vibrations sooner. Owing to this cause a side flash from a thin iron wire is actually less likely to occur than from a stout copper rod.

(*To be continued.*)

THE 'CITY OF PARIS' VERDICT.

THE inquiry instituted by the Board of Trade into the cause of the accident to the '*City of Paris*' has been concluded, and a verdict rendered as follows: "In the judgment of the Court, full provision was made to insure the safety of the '*City of Paris*' as an ocean-going steamer, and safety was in no way sacrificed to speed. We consider cast-steel a proper and suitable material to be employed generally in the construction of the various parts of the engines hitherto usually made of cast-iron. The propeller shafts, both inboard and outboard, appear to have been sufficiently supported. Those of the port engine showed little or no signs of wearing. The after bracket is properly constructed, and is of sufficient strength for the shafting and propeller it has to support. The bushes in the stern tubes and after brackets and the linings of the casings are of suitable material and are properly constructed. The cylinders, pistons, rods, and other parts of the machinery are also of suitable material and well constructed.

"The bulkheads are sufficiently strong to stand any pressure, assuming that any two compartments are flooded at the same time, in any state of the weather. The longitudinal bulkhead between the engine rooms is sufficient strength and is carried sufficiently high. The cracks in the cast-steel columns caused by contraction were repaired with steel plates in a very efficient and workmanlike manner.

"The primary cause of the casualty was the extraordinary wearing down of the brass in the bracket supporting the extreme end of the propeller shaft, whereby the end dropped about seven inches, producing a bending effect on the shaft at its forward support with each revolution. This probably produced finally a total fracture. The cause of the water finding its way into the compartments was that a large portion of the low-pressure cylinder fell against the condenser, tearing it away and thereby opening a large communication with the sea, through which the water rushed in such volume that before any of the inlets could be closed they became covered with water and out of reach. The water passed into the dynamo room and port engine room through the bulkheads, which were broken by the ruptured machinery, and into the two compartments by the injury to the valve box in the engine room.

"After the practically unanimous testimony of eminent authorities of the Board of Trade, and Lloyds, and other experts, upon the strength, completeness, and efficiency in all respects of the ship for the service for which she was especially designed and built, the Court does not consider itself in a position to offer suggestions thereon. During the course of the inquiry we had evidence that, even if some of the forward compartments of the ship had been filled with water in addition to those that were filled, she would still have had a fair amount of freeboard, and would have been able to float, her mean draught on reaching Queenstown being only eight inches more than when she left New York.

"We are of the opinion, having regard for the trying ordeal through which she passed, that the vessel proved herself to be one of the finest and safest in the mercantile marine."

The Court suggested, as points worthy the consideration of naval architects and marine engineers, but not as intended in any way as an adverse comment upon the vessel, the invention of a governor to control marine engines in the case of similar breakdowns, the desirability of isolating each water-tight compartment as far as possible, and the improvement of the supports of the outboard bearings of long propeller shafts.

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SPONTANEOUS combustion is sometimes caused by an accumulation of oiled rags, and sometimes by a collection of insurance policies.—*Elmira Gazette.*

OVERCROWDING PASSENGER STEAMERS.

IN view of the large number of passengers carried on passenger and excursion steamers during the season of summer travel, and the frequent complaints that many carry an excess of passengers over the number allowed by their certificates of inspection or excursion permits, it is desirable that officers of the Government whose duty it is to prevent such abuses shall give especial attention to the matter and prevent the overcrowding of such steamers by prosecution for penalties, if such action shall be found necessary.

Collectors and surveyors of customs are, therefore, directed to instruct their subordinates to make careful examination of such steamers and to report all cases of violation of law for prosecution. Extra efforts in this direction should be made upon Sundays, and particularly upon the Fourth of July. The section of law referred to herein reads as follows:

> Section 4496. All collectors or other chief officers of the customs, and all inspectors within the several districts, shall enforce the provisions of this title against all steamers arriving and departing.

Supervising inspectors will instruct the local inspectors to detail one-half their force upon each alternate Sunday for duty in the vicinity of their home ports for the purpose of ascertaining by actual count of passengers, if necessary, whether the law is complied with, and upon the Fourth of July the whole force will be so employed. Inspectors of steam vessels will confer with the chief officers of customs of their districts as to the best methods of carrying out this order. In all cases where it is found necessary to prosecute, the officer prosecuting will report all the facts to the department for its information.

A zealous effort on the part of the officers named herein in the performance of the duties required, will, it is believed, effectually check the evil complained of.

In view of a conflict of opinion having arisen in some of the districts as to the authority of inspectors issuing excursion permits on waters not included in the local inspection district issuing such permit, inspectors are informed that any local board of inspectors can issue an excursion permit under Section 4466, Revised Statutes, to any steamer then in the waters of their district, to cover all the waters named in the steamer's regular annual certificate of inspection, she being properly equipped and safe, in their judgment, to carry the additional passengers; and such excursion permit is valid, even though used in waters wholly without the district in which the permit is issued.

JAMES A. DUMONT,
Supervising Inspector-General.
Approved, June 7, 1890.
WILLIAM WINDOM, Secretary.

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PUT not your trust in politicians. Engineers can lay this to heart, for they have need to. In one way or another they have occasion to ask the public service of politicians whom they may have worked hard to elect to the offices they hold; when aid is asked of the politician his promises are profuse, but his performance is nothing. Politicians are selfish men, who grind their axes by the voluntary service of the public, but they never grind anybody's axe unless they see it is going to be used to do work for them.

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A VAST sum was sunk in the temporary plant used in building the Forth bridge. The engineers estimated that £500,000 was spent in this direction alone. In scaffolding, flooring, shedding, etc., 1,000,000 cubic feet of timber were used. From first to last 1,200 tons of mere service bolts were needed to hold the material together. Scores of hydraulic jacks, sixty miles of wire rope, and rams innumerable, were also among the temporary appliances employed.

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THE polite way to tell people they are growing old is to say that they look younger than ever.

THE NEW YORK CENSUS.

IT is easier to get in or out of New York than it was ten years ago.

Ten years ago the park area in New York City was 1,094 acres. Now it is 5,000.

Ten years ago there were 4,000 Hungarians in New York. Now there are 20,000.

Ten years ago the Italian population in the city was 12,223. This year it is 45,000.

The death rate in New York per 1,000 inhabitants has declined during the past ten years from 26.2 to 24.

Ten years ago the tenth ward of this city had an average population of 432 to the acre. In 1870 it had 377. This year it has 540.

According to the census of ten years ago, the foreign born population in the city was then 478,670. This year it is computed to be 675,000.

Ten years ago there were 10,000 natives of Poland and Russia in the City of New York. Now there are 50,000 Poles and Russians and their descendants.

There are fewer theatres in New York than there were ten years ago. There are, in proportion to the population, fewer drinking saloons. There are more churches.

There has been during the past ten years no increase, substantially, in the number of residents of New York, of Swiss, Belgian, Dutch, French, Welsh, or Scandinavian birth.

The census will not disclose the fact, but twice as many young men and young women between the ages of 18 and 28 are obliged to wear glasses as wore them ten years ago. The change in climate chiefly accounts for the great increase.

By the census of 1880, the population of the City of New York at that time was 1,206.299. This year's census is expected to show a population of 1,675,300. There has been no increase of geographical boundaries during the intervening ten years.

Ten years ago there were 163,482 natives of Germany in the City of New York. This year there are 200,000—more Germans in New York than in Bremen, Frankfort, Cologne, Stuttgart, Dusseldorf, Lübeck, Crefeld, Nuremberg, Stettin or Leipsig.

Typewriters and telegraphers have increased more rapidly during the last ten years than any other class of persons in proportion to their numbers in 1880. A majority of the typewriters employed in New York reside in Brooklyn or Jersey City.

Ten years ago there were in New York 96,402 buildings—houses, stores, hotels, theatres, stables and public department buildings. This year there are 114,500—an increase of 18,000. Forty-two thousand buildings are in the territory north of Fifty-ninth Street.

The number of residents of the City of New York who can neither read nor write is less now than it was ten years ago. But the number of residents of the city who can neither read nor write the English language has increased 40 per cent. during the last ten years.

Ten years ago the estimated value of real estate in this city was one thousand million dollars. The exact figures were $1,049,340,336. This year's valuation of real estate in New York is $1,500,000,000—just 50 per cent. more, and an increase at the rate of fifty million dollars a year.

On an average 35 more boys than girls are born in New York every week. On the average 55 more males than females die in New York every week. By force of natural increase, therefore, the female population grows more rapidly than the male. During the past ten years, from this cause alone, the female population of the city has increased 10,000 more than the male population.

Speaking of the female population only, there are fewer blondes, more brunettes, and just as many auburn-haired girls and women as there were ten years ago. As the climate gets milder, the number of dark-haired persons increases, and the change has been more marked by the fact that most of the immigration of New York city has, of late years, been from the southern countries of Europe, and from the southern portions of the northern countries.

Putting the probable population of the city this year at 1,675,000, there are more people in New York than in any one of the following States: Alabama, Arkansas, California. Colorado, Connecticut, Delaware, Florida (more than the total population of the last four combined), Kentucky, Kansas, Louisiana, Maine, Maryland, Minnesota, Mississippi, Nebraska, Nevada, New Hampshire, New Jersey, Oregon, Rhode Island, South Carolina, Vermont, West Virginia, or in the four new States of North and South Dakota, Washington, and Montana.—*N. Y. Sun.*

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IF New York laws governed the formation of all corporations which do business in New York very few would be organized. Nine-tenths of the new corporations being formed by New York men for distinctly New York purposes are being organized under New Jersey charters. For example, the North American Company, organized a few days ago under New Jersey laws with a capital of $50,000,000, would have been a New York corporation but for the onerous burdens our laws impose. The fee which New Jersey received for issuing the charter to this company was $10,000. New York would have required a preliminary fee of $62,500. New Jersey will tax the company annually only on such property as it actually owns in the State. New York would have imposed an annual tax of two per cent. upon the value of the entire capital. Immediately after the New York Legislature recetly revised the corporation laws to the above effect, New Jersey shrewdly reduced her requirements of corporations to a minimum. She is harvesting rich returns at New York's expense, for it is said that the total capitalization of new corporations chartered in New York since the law was changed amounts to only about $30,000,000. In New Jersey the capitalization of really New York corporations recently amounts to some hundreds of millions.

◆

THE adoption of mineral oil as an illuminant for channels has made it possible to use a burner which can continue lighted for three, five, and even eight days and nights, without attention of any kind. Such burners have been attached to pier heads, piles and to isolated beacons, inaccessible in heavy weather. With lard oil these lights could only have been maintained in lighthouses arranged for keepers to live in them, as the lard-oil burners would grow dim and finally go out unless trimmed every few hours. The building of the lighthouses would cost anywhere from $25,000 to $250,000 each, and each lighthouse would require from three to five keepers. The three, five or eight-day burner mineral-oil lights are established at a cost of from $50 to $500 each, and one man with a rowboat can attend to as many as he can reach in his boat. Thus the adoption of mineral oil as an illuminant has made the establishment of isolated harbor, bay and sound lights inexpensive. There are 1,400 of these lights on Western rivers. The establishment of these lights has revolutionized steamboating, and it has made it as safe for boats to run by night as by day.

◆

A GERMAN named Lilienthal, after experimenting for twenty-three years with artificial wings, has succeeded in raising himself, weighing 160 pounds, with the aid of a counterweight lifting eighty pounds. How to lift the other eighty pounds is still beyond him.

◆

WE are desirous of obtaining several serial articles for the coming fall and winter, and will thank all who have practical matter of this class to submit their copy. Essays are not wanted.

TRADE NOTES.

THE Customs people are looking after steam yachts around the bay. Many, it is said, fail to observe the customs regulations as to obtaining certificates of inspection. There is a fine of $500 for such neglect.

* * *

F. C. & A. E. ROWLAND, New Haven, Conn., machinists, have finished an immense board cutter, the first of the kind manufactured. The machine is to be used in the Eagle Saw Mill, Brooklyn. It is 40 feet long, 16 feet wide, and 16 feet high, and weighs fifty tons It is fitted with a knife by which it can cut boards 8 feet long by 2½ wide at the rate of forty a minute, and plane the board at the same time. Its cost is $12,000.

* * *

NEW YORK harbor has two ship channels having a depth of from 21 to 32 feet at low tide and 27 to 39 feet at high tide, and is capable of admitting vessels of the heaviest draught. It also affords safe anchorage at all seasons. The length of the city's water front is,on Manhattan Island shore $30\frac{7}{10}$ miles, and on the Westchester shore and islands $29\frac{9}{10}$ miles, or a total of 60 miles, about 15 miles of which around Manhattan Island is available for commercial purposes. There are 230 piers around the city—114 on the North River, 93 on the East River, and 23 on the Harlem River—and new piers are constantly being built.

* * *

A REPORT received at the Navy Department from Admiral Walker, describing the condition of the bottoms of the vessels of the squadron of evolution when docked at Malta, has created considerable anxiety as to the condition of the steel plating of the '*Yorktown*,' and her bottom will be examined with great care when she is put in dry dock at New York. The report shows that all the vessels of the squadron were thickly coated with marine growth, while the plates of the '*Yorktown*' were badly pitted by the action of the salt water. Impressions were taken of some parts of her bottom, and these accompany the report, showing with great exactness the extent of the corrosion.

* * *

THE Ordnance Bureau of the Navy Department has just completed a series of tests, at the Annapolis proving ground, with the last ten-inch gun finished at the Washington Ordnance Foundry. The test was in every way highly satisfactory. The gun developed a maximum of 2,000 yards initial velociry, with the extraordinarily low pressure of fourteen tons in the powder chamber. This indicates that it will be an exceptionally efficient and durable weapon. It is the best gun yet built in America, and so far as is known at the Navy Department, no other gun in the world has given such good results on trial.

* * *

NAVAL Constructor Francis T. Bowles is soon to resign, and is to have the management of a great shipyard, which a syndicate of capitalists is making arrangements to build at Chester, Penn., on the foundation of the old Roach yard, now operated by N. F. Palmer, Jr., & Co. This yard is to be equipped with all the latest tools and machinery, and is to be especially adapted to the construction of naval vessels on a large scale. Mr. Bowles is one of the ablest men in the construction corps. He has been for some time in charge of the construction work in the Norfolk Navy Yard, and his controversy with the Bureau of Construction and Repair over the weight of the battleship '*Texas*' will be well remembered. He has been almost continually in controversy with the bureau, and will no doubt be glad to be in an independent position.

* * *

CONGRESSMAN WHEELER, of Michigan, whose Bay City shipbuilding firm failed to get the contract to build the practice vessel for the Naval Academy, because an old treaty with Great Britain seemed to the cabinet in the way of building a war vessel on the lakes, has decided to sell out to a British syndicate, and this week will arrive in London to complete negotiations. Arrangements for the sale of his yards were almost closed three months ago, but fell through at the last moment. Within the past month, however, a new syndicate was formed in London by Swithenbank, Innes & Co., brokers. The Wheelers are to sell their acres of yards, buildings, and good will and uncompleted contracts, to a company with a capital of $2,000,000, the American firm to retain $750,000 in stock. Large rolling mills and blast furnances are to be built by the new concern, and the business of iron shipbuilding for both the lake and Atlantic coast trade is to be pushed. The Wheelers already have built two iron steamers for the coal trade between Newport News and Boston.

* * *

NO official information as to the speed attained by the cruiser '*Philadelphia*' on her trial trip has yet been received at the Navy Department. The vessel was designed for greater speed than the '*Baltimore*,' but she does not seem to be much, if any, faster. In fact, if the record of the patent log on the '*Baltimore's*' trial is even approximately correct, she is the faster vessel of the two. The record of that log is, however, open to considerable doubt. A comparison based on the work of the screws also gives the advantage to the '*Baltimore*,' but not so decidedly as the log record. The pitch of the '*Baltimore's*' screw is, in exact figures, 21.565 feet, and they made on her trial trip 118 revolutions per minute. The '*Philadelphia*,' with 20.392 feet pitch, is reported to have made 120 revolutions per minute. Without allowing for slip, which would be substantially the same in both cases, the '*Baltimore*' would have made 2,544.67 feet per minute, and the '*Philadelphia*' only 2,447. The two vessels are so evenly matched that a race between them over a forty-mile course would be a very interesting exhibition.

* * *

IN Northeastern California some very long flumes have been constructed for conveying timber from the site of its growth to the saw mills. One of these is forty miles long, and the timber costs but two dollars per 1,000 feet for transport over this distance, as compared with nine dollars, the cost of transporting it by teams. These flumes are known as V flumes, being made of two twenty inch boards battened on the outside at every joint; a piece is laid across the bottom of the flume inside and about four inches from the bottom to prevent the boards getting stuck. The flume is five feet across the top, and its height depends on the country traversed. The flumes sometimes run for long distances at angles of thirty to forty degrees, and in order to check the fall of the timber these rapid slopes are followed by long stretches of level, in which the water resumes its normal velocity. A first-class flume costs $5,000 a mile, and will carry, without being pushed, 100,000 feet of lumber and fifty cords of wood per day.

* * *

ICE is cheaper in Savannah, Georgia, than in the North and West, says a Southern paper. The day of high prices for ice has disappeared, and ice syndicates will soon be a thing of the past, as machines for making ice have revolutionized the trade in the South. Is has been only within the last few years that Savannah and the interior depended wholly on natural ice brought in vessels from the North. When the ice crop was a failure prices went out of reach of those in moderate circumstances. Northern cities, to a large extent, still depend on the natural ice supply, and, the open winter being unfavorable and the ice output light, ice is wholesaling in New York at $10 per ton, and in Cincinnati at $20 per ton. In Savannah ice by the ton ranges from $5 per ton to $7.50, the highest figure, and, while the demand exceeded the supply, there is no danger of an ice famine or high prices. Ice retails all the way from two-fifths of a cent per pound to three-quarters of a cent per pound, in five to fifty pound lots, and nearly every corner grocery and little shop throughout the city retails ice, so that there is a large amount of ice consumed daily.

* * *

THE new steam yacht '*Aztec*,' to be launched next week at the yards of Charles L. Seabury & Co., Nyack, cannot be surpassed. The '*Aztec*' is for Mr. D.A. Loring, of New York, and will cost $16,000. She is 75 feet over all, 11 feet 6 inches beam, and 5 feet 6 inches deep. Her model is from Seabury designs. She will be schooner-rigged, and will be fitted with Seabury safety water-tube boilers and triple expansion engines of 160 horse-power. Her cabins are finished in mahogany, and she is perfect in appointments, every inch of space being utilized. Her main saloon is furnished with sofa beds, and is arranged to make four distinct staterooms. She can also be made in a few moments practically an open cabin yacht.

The same company recently launched the '*Veda*,' a 33-foot yacht built for Mr. F. B. Clark of New York City. Work is also progressing at the Seabury yard on a 36-foot yacht for the Goldsboro Land and Improvement Company of Bar Harbor, Me.; a 36-foot yacht for W. R. Lawrence, Yonkers; a 30-foot liquid fuel launch for Sinclair Smith, New York, and a 22-foot steam launch for I. T. Smith of Brooklyn. Several other boats are in course of construction. All these are fitted with Seabury safety boilers and engines. They are also building a 40-foot launch, only five feet wide, to attain a speed of seventeen miles per hour from 60-horse-power compound engines.

* * *

ARRANGEMENTS are under way for the purchase by an English syndicate of the Roach shipyards in this city and at Chester, the price agreed upon being $4,000,000. The transfer may be made in a few weeks, and then England will go into the business of building our ships in this country at perhaps a greater profit than she now gets for building them in her own shipyards. The property secured includes the plant at Chester and the Morgan Iron Works here. In connection with the sale some interesting information is made public regarding the profits earned by John Roach in his business. A London auditor has heen examining the books of the concern from 1872 to date, and reports that Mr. Roach's profits for the ten years ending in February, 1885, were $4,216,837, or an average of $421,683 a year. Regarding the years 1885-'86, when Mr. Roach and the Government were in dispute, the directors of the new company excluded those years from the estimate. The work done during the subsequent years to date is reported to have been: 1887, $829,616; 1888, $1,203,367; 1889, $2,701,384. The estimated profit on the last year's business is placed at $427,322. On the basis of present earnings the purchasers expect to pay 12 per cent. on the common stock. The board of management of the new corporation in the United States will consist of John B. Roach, George E. Weed, Henry Steers, and William Rowland.

BY dispatches all over the country come complaints that the census is unreliable, in that numbers in large cities have not been visited. If this is the case in large towns it is apt to be true of smaller towns and villages, and there is good reason to believe that much carelessness and laxity has occurred. They do this thing better in England. Blanks are delivered at every house, office, hotel and building that is occupied. Instructions as to filling out the list accompany the blanks, which are delivered by policemen familiar with the different locations. It is ordered that between 11 and 12 o'clock that night a blank shall be made out for every person under the roof at that time. Next morning the blanks are returned, and the census has been taken. At the hour designated most of the people are under some roof. Those who work at night are taken at their offices, and their families are taken at home. People are taken wherever they happen to be at that hour. Then they are cautioned not to be enumerated again. Few errors are made, the work is easy, and the expense hardly anything.

◆

IT is a fact that shouting into a telephone is not so effective as a moderate tone of voice. The reason is plain. Since the diaphragm can only vibrate so much under any circumstances, a violent sound-blow simply breaks up the vibrations into chatters or rebounds, so to speak, from the normal vibration due to the capacity of the diaphragm. Most persons use a telephone as though it were a speaking trumpet, and it was necessary to roar in it. If they would find the tone or volume of sound necessary to the distance traveled, and use that, the work done would be much better, and less nervous energy would be expended.

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IN former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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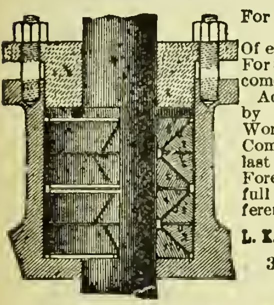

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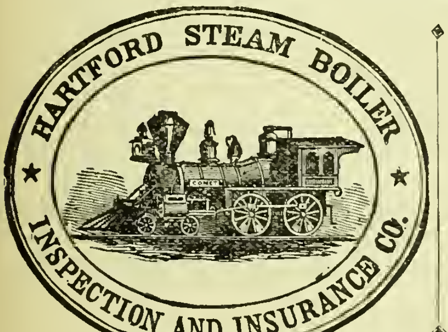

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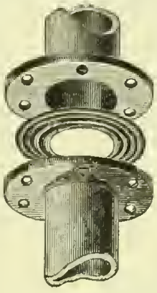

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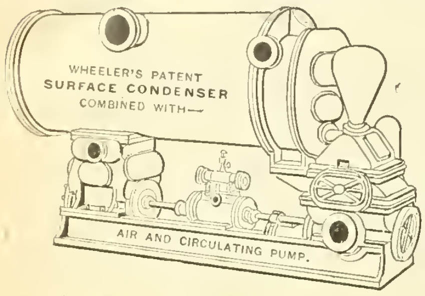

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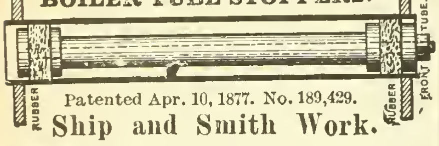

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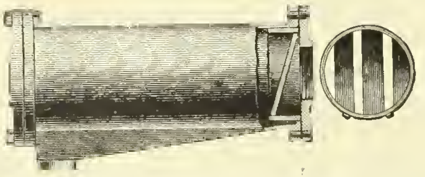

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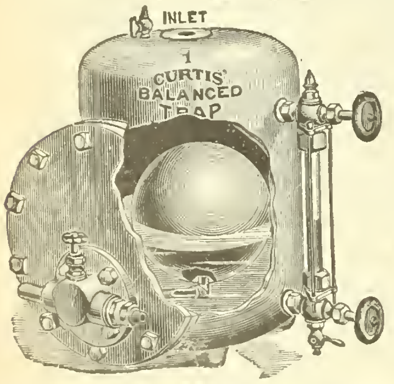

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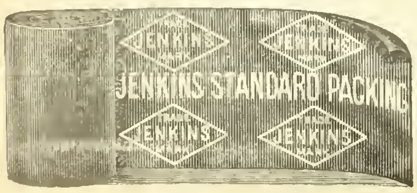

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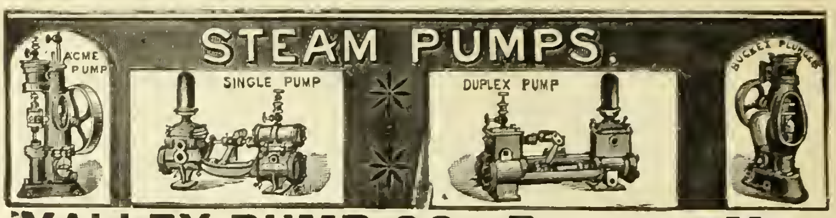

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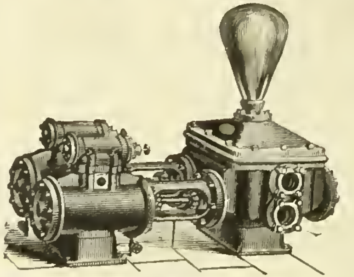

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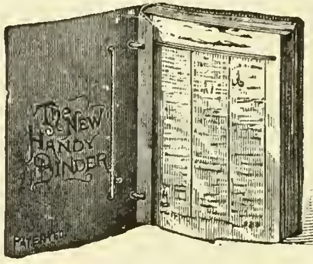

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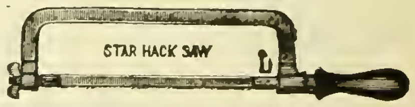

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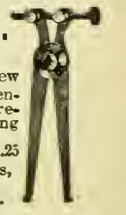

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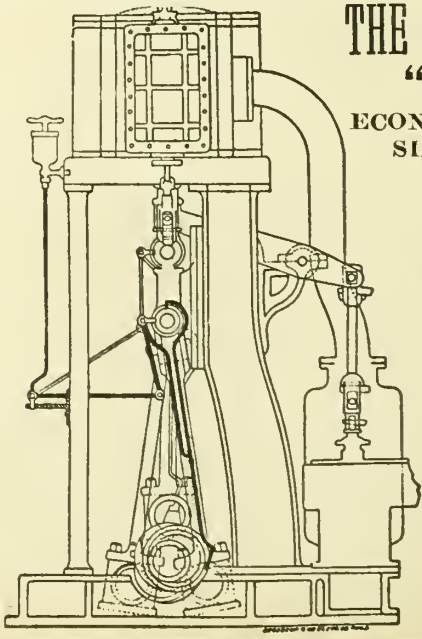

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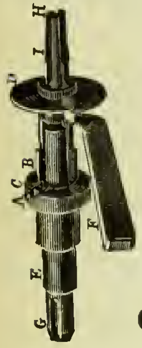

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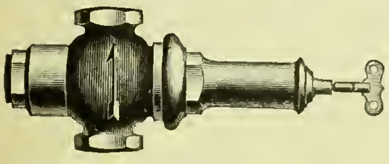

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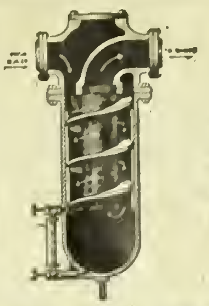

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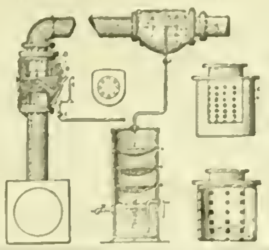

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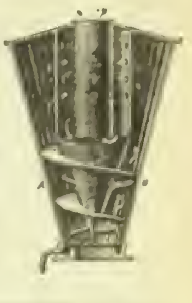

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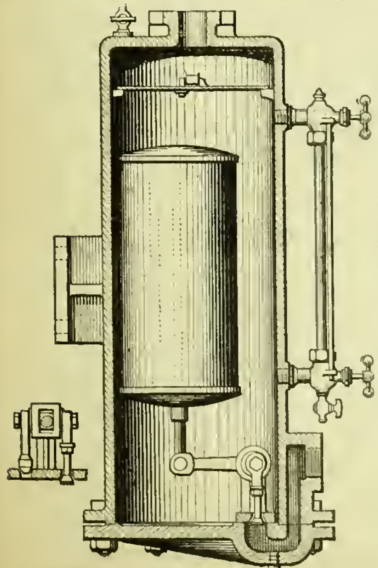

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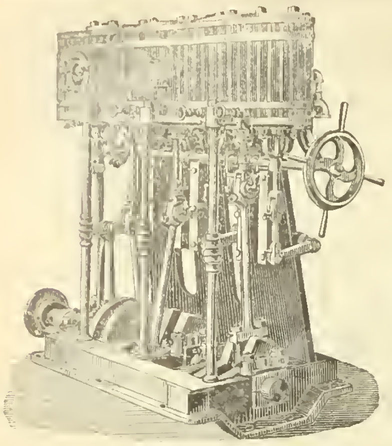

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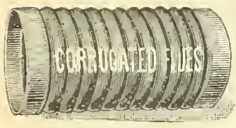

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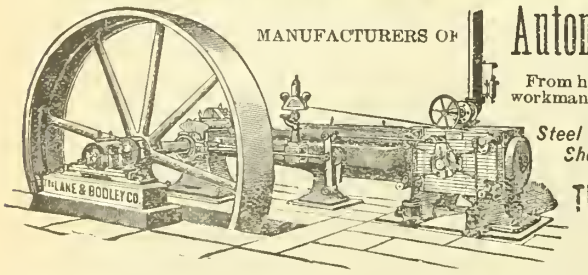
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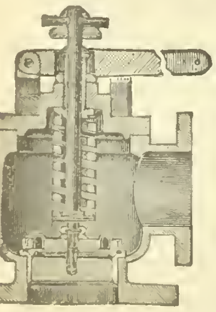

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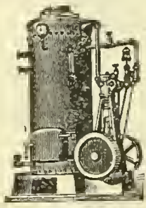

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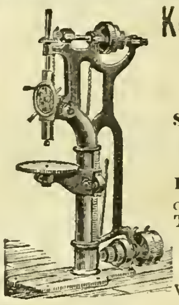

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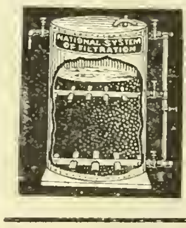

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THE ENGINEER.
NEW YORK
NEW SERIES, 1883, 1888. **Vol. XX. No. 2.**
TENTH YEAR OF PUBLICATION.
STEAM ENGINEERING, APPLIED MECHANICS, AND THE ALLIED ARTS.
$2.00 PER ANNUM. - SINGLE COPIES, 8 CENTS.
July 19, 1890.

ENGINES OF THE 'MARIPOSA.'

IMPROVED MORTON VALVE GEAR.

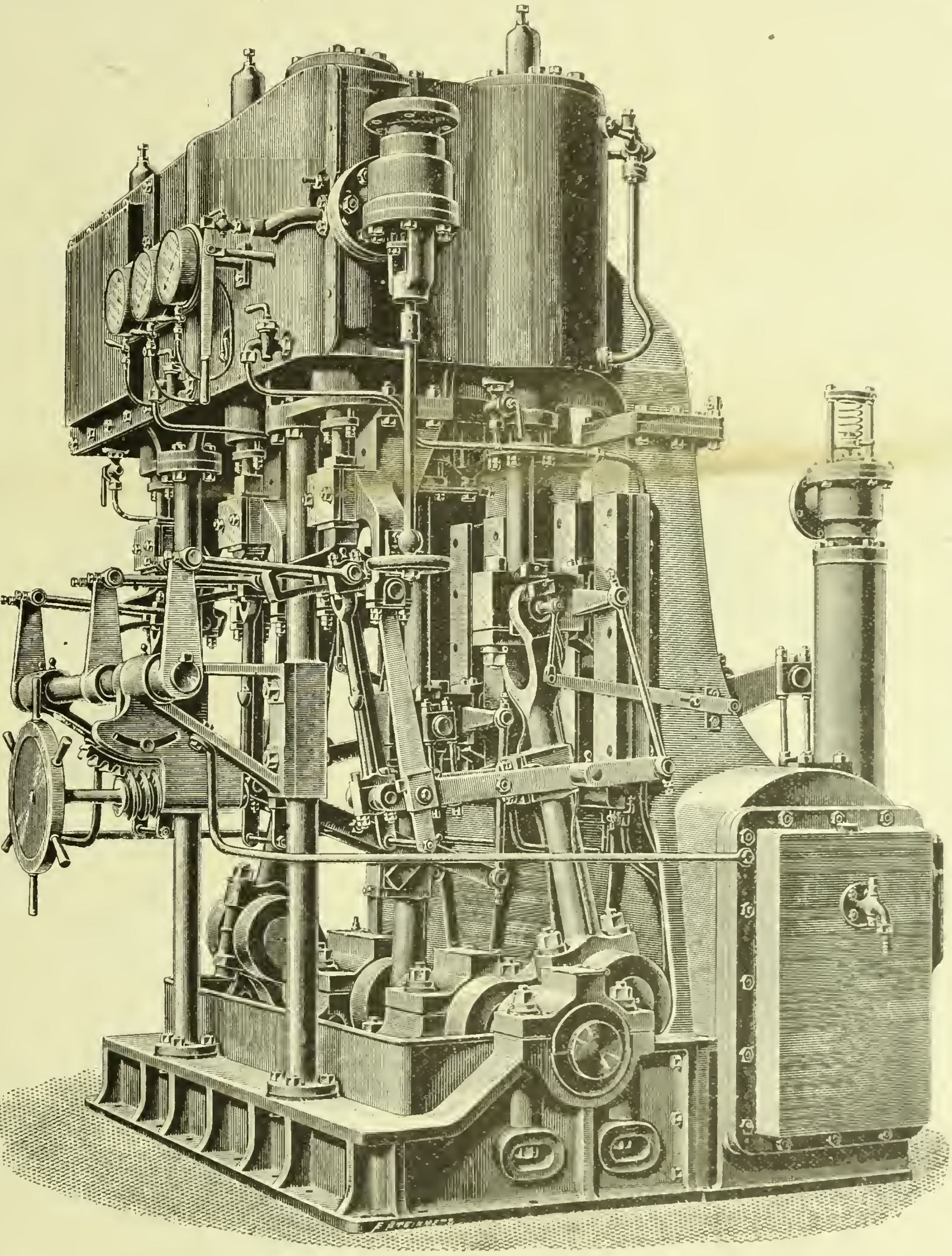
THE engravings show the triple expansion engines of the '*Mariposa*,' a steamer which has the Morton valve gear.

The cylinders are 11 in., 18 in., and 25 in. in diameter, with a stroke of 18 in. The high-pressure and intermediate-pressure cylinders are fitted with piston valves of improved design, the low-pressure cylinder having an ordinary double-ported slide valve, the total travel of each valve in full gear being $2\frac{5}{8}$ in. Each valve chest is placed on the cross-center line of its engine, and at equal distance out from the fore-and-aft center line of the engines, so that the corresponding parts of each set of valve gear are interchangeable.

At the official trial the engines developed 244 i. h. p., making 174 revolutions per minute.

The special feature of interest is the reversing valve gear. The new features are the means whereby the port opening in either forward or backward gear is equal for equal movements of the main piston from either end of its stroke, with a constant lead at any grade of expansion.

The mechanical details employed, new, so far as the purposes for which they are adopted in the Morton system of reversing valve gear is concerned, are the radiating crank *P*, the sliding expansion quadrant *I*, and the adjustable link *H* (see next page). The functions of the various members of the new system will be understood from the following description:



The radiating crank *P* is carried in a projection on the connecting rod, so proportioned that its pin *A* radiates equally across the center line of the connecting rod, and remains practically stationary in relation to the center line of the connecting rod during a revolution of the engine. Movement is imparted to the pin *A* in double-cranked engines through the link *B*, attached to the crosshead slide at *D*, which actuates the prolonged end of the "lead" or valve lever *F*. Thus it will be seen that the travel or movement imparted to the radiating crank-pin *A B* is in a relatively contrary direction to that in which the piston may be moving, and of the required amount to correct the error due to the angularity of the connecting rod, but also to compensate and correct the angularity of the "lead" lever *F* by one and the same movement, so that the fulcrum center *G* of the lever *F*, which moves on an arc described by the link *C*, vibrating from the fixed center *K*, has a motion imparted to it in time with that of the piston. The overhung end *G N* of the lever *F* is so proportioned as to travel the amount of the "lap" + "lead," and, when the crank of the main engine is on either the top or bottom center, and the engine in "mid-gear," the center line of the adjustable link *H* lies through the center of the valve spindle and parallel to the center line of link *C* and that of the connecting rod. The expansion quadrant *I* is curved to the radius of the adjustable link *H* and fitted with a die block *J*, to which the link *H* is connected, and these two pieces are again connected to the levers on the reversing shaft by a drag link. The position of the die block *J* in the quadrant regulates the degree of expansion, or the direction of the engine's rotation, and when the engine is "on the center" the die block *J* may be moved from right to left without moving the valve. The stem of the quadrant *I* is made of square section, and into its end is fitted the valve spindle, secured in place by a cotter, the spindle guide being formed in the bracket on which is cast the arms for carrying the fixed center *K*.—*Engineering*.

◆

THE man who goes banging, bumping and buzzing through the world, like a bumble bee against a window, stepping on everyone's toes, and ruffling everyone's sensibilities, has only himself to blame if he finds himself unpopular. A good many of us are fools, and do foolish things; but we hate to be bluntly told of them and crushed flat by an unauthorized fool-killer. We all like the man who humors our frailties, and, though seeing them, does not drag them forth into the cruel light of day to be scorned by all.

◆

A FEW inventors have not yet fully realized the utter hopelessness of any effort to introduce car couplers which are not of the Master Car Builders' type, and some of them spent money and time to show their inventions at the convention. The sooner they abandon this line of effort the less time and money they will waste

SPECULATION ON THE ‘CITY OF PARIS’ DISASTER.

Mr. John Watt writes to *Engineering* as follows: “From the evidence given and the opinions expressed at the Board of Trade inquiry into the recent disaster to the ‘*City of Paris*’, not much light has been thrown on the primary cause of this unfortunate occurrence.

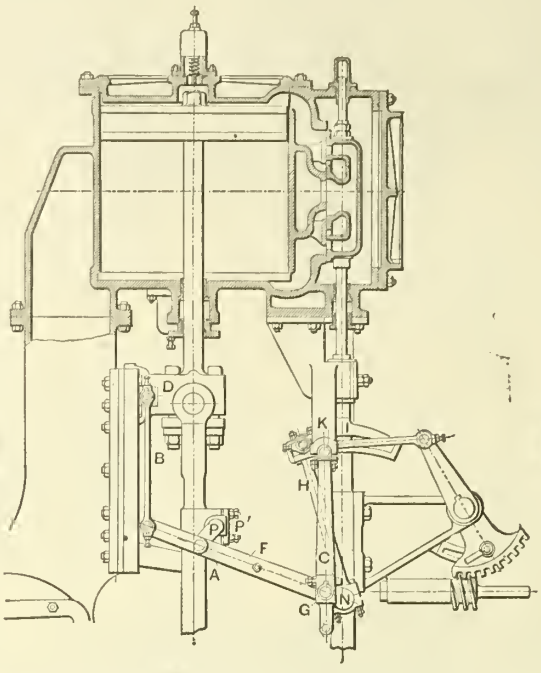
“When the vessel was placed in the graving dock it became self-evident the engine-room disaster was attributable to the shaft breaking; this in turn to an excessive wearing down of the stern bush, and this again to the bursting or splitting of the brass liner on the propeller shaft within the stern bush.

“From what was to be seen of the remains of this liner, there can hardly be two opinions but that it had burst or split; but with reference to the abnormal force to effect this after some twelve months’ running, there is little or no evidence or opinion brought forward. With your permission, therefore, I venture to submit a few observations that will meet the various points of the case.

“One thing that strikes an observer is the way in which the outboard shafting is inclosed and protected by a casing from the stern-gland to the propeller boss; not that this casing is absolutely water-tight, but in a great measure it prevents the free access of water to the stern bush. Again this stern bush is so constructed that it cannot be drawn from the *after* end in the event of repairs or refilling. In order to get the bush out the whole of the outboard would have to be taken down—a work of no ordinary magnitude. This will be seen to be a grave defect in the design, and to it may be attributed in an indirect manner the cause of the disaster.

“Now, the evidence goes to show the bush was repaired or partially refilled with lignum vitæ *in place*, not that other bushes have not been successfully repaired in this manner; but when it is considered, the workman has to fit in these strips between the shaft and bush for a distance of some 6 ft., only by the greatest care would the shaft become properly bedded over the whole surface. The weight on the bearing is about 35 tons, and the surface velocity of shaft about 500 ft. per minute.

“Taking all these points into consideration, it does not require a great stretch of the imagination to trace the result. In her run down channel heating would take place, the liner and shaft gradually expanding. When she came to anchor at Queenstown the liner would be the first to cool and contract; but the contraction has been too much for the liner, and hence bursting or splitting is the result. Again, in this case the liner was further secured to the shaft by a number of brass screws, and the line of fracture would most probably be through a line of these screws, one edge freeing itself while the other would be held down by the screws. When the shaft cooled and contracted to its ordinary dimensions, the loose edge of the liner would be left projecting above the other. With regard to the remainder of the screws, these would prevent the liner from leaving the shaft in their immediate vicinity, so that the liner would be anything but a true circle. In this state, then, the ship resumed her voyage. The cutting and grinding commenced. First the edges of the liner would tear out the lignum vitæ, then brass on brass till both disappeared, and lastly steel on steel, and this, too, evidently at a much greater rate than of old, when wrought-iron shafting ran in cast-iron bushes. To many the theory of a bearing getting hot some 15 ft. under water will appear absurd; but strange phenomena do occur. The chemist manufactures ice in red hot crucibles, or with a piece of potassium sets water on fire. The brightness of a shooting star reveals to the astronomer that a moving opaque body in our atmosphere is wasting its substance by excessive friction. So now the engineer has the honor of creating sufficient friction as will produce heat enough to destroy stern bushes.”



THE MORTON VALVE GEAR.

◆

HOUSTON'S SHORT CIRCUIT DRAUGHT FOR LOCOMOTIVES.*

The invention herewith illustrated shows a very simple and ingeniously worked out device for improving the draught of locomotives and dismissing the products of combustion, including the cinders, by as short a circuit as possible. It is the conception of Charles Houston, a locomotive engineer on the Central Railroad of New Jersey, and has been in operation for some months on No. 145, an old engine of the Standard class, in passenger service. The idea of the inventor was to reduce the area cleared by the exhaust to its lowest terms. This would entail much less work upon it and allow the nozzle to be larger than those in general use, which would, of course, reduce the back pressure to a certain extent, adding to the efficiency of the actual pressure. To carry out his conception, the forward tube sheet is surrounded by a sheet-steel hood, as shown in fig. 2, and in section in fig. 1. This hood leads by easy curves directly to the stack, the base of which is prolonged, as shown, to within a few inches of the hood. This base is also perforated, which permits the small cinders to pass through, but at *A*, *A*1, there are larger openings through which any large cinders are thrown directly into the smoke-box extension. At *B*, fig. 1, a small pipe enters the nozzle stand and turns around it, directing its jet out of the lower opening at *A′*; this is to throw out such cinders as lodge at the base of stand, and are too large to go out through the screen. At *C* and *D*, fig. 2, is shown the arrangement of air pump exhaust and blower pipes. Fig. 2 is a front view of the device; the front above the nozzle can be taken off for examination, or to clean the nozzle or screen. It will be seen that the steam pipes are entirely outside of the hood, and their leaking will not affect the steaming qualities of the engine.

So far as known at present this arrangement is a marked improvement over the old netting and tortuous passage smoke-box in general use. There is no netting to be cut out, gummed up, or to offer resistance to the products of combustion by cutting them up into jets one-quarter of an inch square. The engine is an 8 wheeler, 18″×22″ cylinders, with a 5½-foot wheel, and rather a small boiler; hard coal is used in a fire-box 9 feet long and 36″ wide; she originally had a pair of 3″ nozzles, and was changed to a single nozzle 3¾″ in diameter; since this device has been used, the nozzle has been opened to 4¼″. The engine is on express runs, making 138 miles of fast time every day. One noticeable improvement is the even way the fire burns, being alike all over the box; the engine runs 101 miles without using a poker or slash bar. In May, 1889, with standard extension, this engine ran 3,744 miles, using 129 tons of coal; in the same month this year she ran 3,864 miles, using 115 tons of coal, and on one trip daily hauling a five-car train, where last year it was four cars, but it is fair to say that in the meantime the engine has been overhauled. All the repairs on her boiler consisted in taking out thirty-five flues, and piecing them out. The repairs to the machinery do not affect the device in any way. It can be applied with equal facility to a short or an extension arch, and no changes are made in the engine, except making the nozzle shorter, and in the arrangement of the blower and brake exhaust pipes.

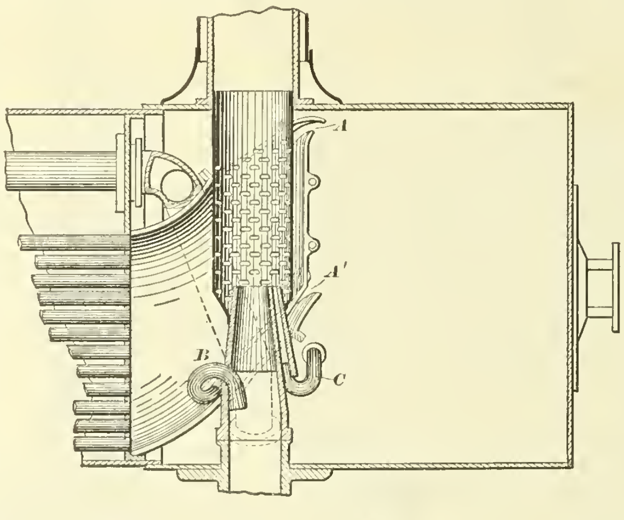


Fig. 1.

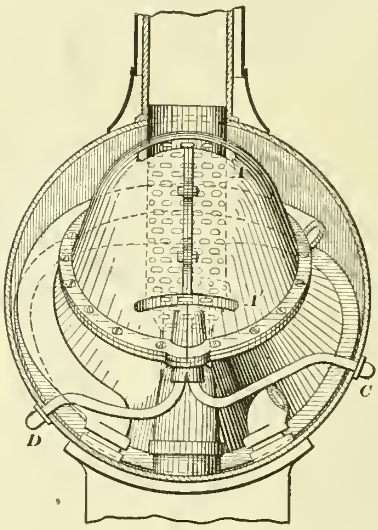


Fig. 2.

◆

With regard to the use of screws to fasten rails, while the adhesive power is greater than the spikes, their ability to resist lateral expansion is much less. Careful tests have shown that it is about in the ratio of two to one in favor of a square as against a round section of equal area. The round, when subjected to pressure, acts as an obtuse wedge to force the fiber of the wood to each side of the center. The other objection to the use of the screw was that it does not give sufficient bearing against the flange of the rail, as it only touches at a point on its periphery. A large quantity of screws were used for fastening on a number of eastern roads about 20 years ago, but after a short trial their use was abandoned, as they were found to be inferior to the common spike for the purposes for which they were required when called for.—*W. G.* (*whoever he is*).

◆

This occurs in the proceedings of the recent convention of railway master mechanics:

“The principal question on which the exhaust nozzle practice of the country splits is, whether the pipes shall be double or single.”

Well, as the trade has been splitting for over thirty years upon it, to our personal knowledge, why not give it up, and say it is a point which admits of no hard and fast rule?

---

* We are indebted to the *Locomotive Engineer*, N. Y., for the engraving.

COLORING OF METALS BY OXIDATION.

THE cause of the appearance of annealing colors has generally, although without any proof, been ascribed to the oxidation of the iron. Mr. S. Stein, well known from his experimental investigations of iron and steel at high temperatures, in the Zeitsch. d. Ver. D. Ing., has now conclusively shown that belief to be well founded. Pieces of iron and steel were carefully cleaned with alcohol and ether, and put into a glass tube; the air was exhausted and replaced with pure nitrogen, which also was pumped out in order to secure a thorough removal of the oxygen. The tube was then gradually heated, and as hydrogen and nitrogen generated from the metals they were pumped out. The inner surface of the tube, on its cooler parts, became covered with a white precipitate of a still unknown nature. The whole scale of the temperatures appropriate for the appearance of the annealing colors was tried, but these failed to appear, whereas they were called forth immediately on the admission, into the tube, of air with oxygen.

Messrs. R. Schwirkus and F. v. Liechtenstein have demonstrated in an experimental way that an increasing hardness of the steel necessitates an increasing heating to produce the same annealing color, and that the composition of the steel affects the conditions for the appearance of the different colors in a still higher degree than the hardness. The combinations of temperatures and colors in the ordinary manuals are thus entitled to only conditional correctness at best.

Another series of experiments relating to the influence on the colors of the duration of the heating, manifested that they can appear at even very low temperatures if they are only kept up long enough, and that the difference between hard and soft steel asserts itself here too. A soft piece exposed during several days to the heat of 177 degrees C. showed purple after 68 hours, violet after 93, and dark blue after 120, whereas a glass-hard piece turned light yellow after 20.5 hours, dark yellow after 27, orange after 50, and purple after 103. At higher temperatures the colors appear with shorter intervals.

◆

A RECENT trial of the new sewage purification works, Worcester, Mass., was entirely satisfactory, and gives reason for the belief that the sewage problem, so vexatious to the people of Worcester, has been solved. We may say briefly that the plant consists of a series of open tanks constructed of brick, having a combined area of about an acre, a mill for grinding chemicals, and vats in which these chemicals are mixed with a small quantity of crude sewage. This mixture is thence discharged into the stream which flows from the sewers into the brick basins where the chemicals, (chiefly lime), combine with some of the impurities, forming a coagulum, which, as it settles, carries with it to the bottom of the basin other impurities, leaving the sewage almost as clear as spring water. This clarified sewage is allowed to flow into the river, and the sludge is drawn off from below and deposited on land adjacent to the works, where it will be plowed under. The basins are so constructed that all may be used simultaneously, or the flow of sewage cut off from anyone or more of them for removing the sludge, for cleansing or repairs.

◆

A NEW musical instrument is announced. A bass fiddle big enough to make a little catboat—fourteen and a half feet over all and eight and a half beam.

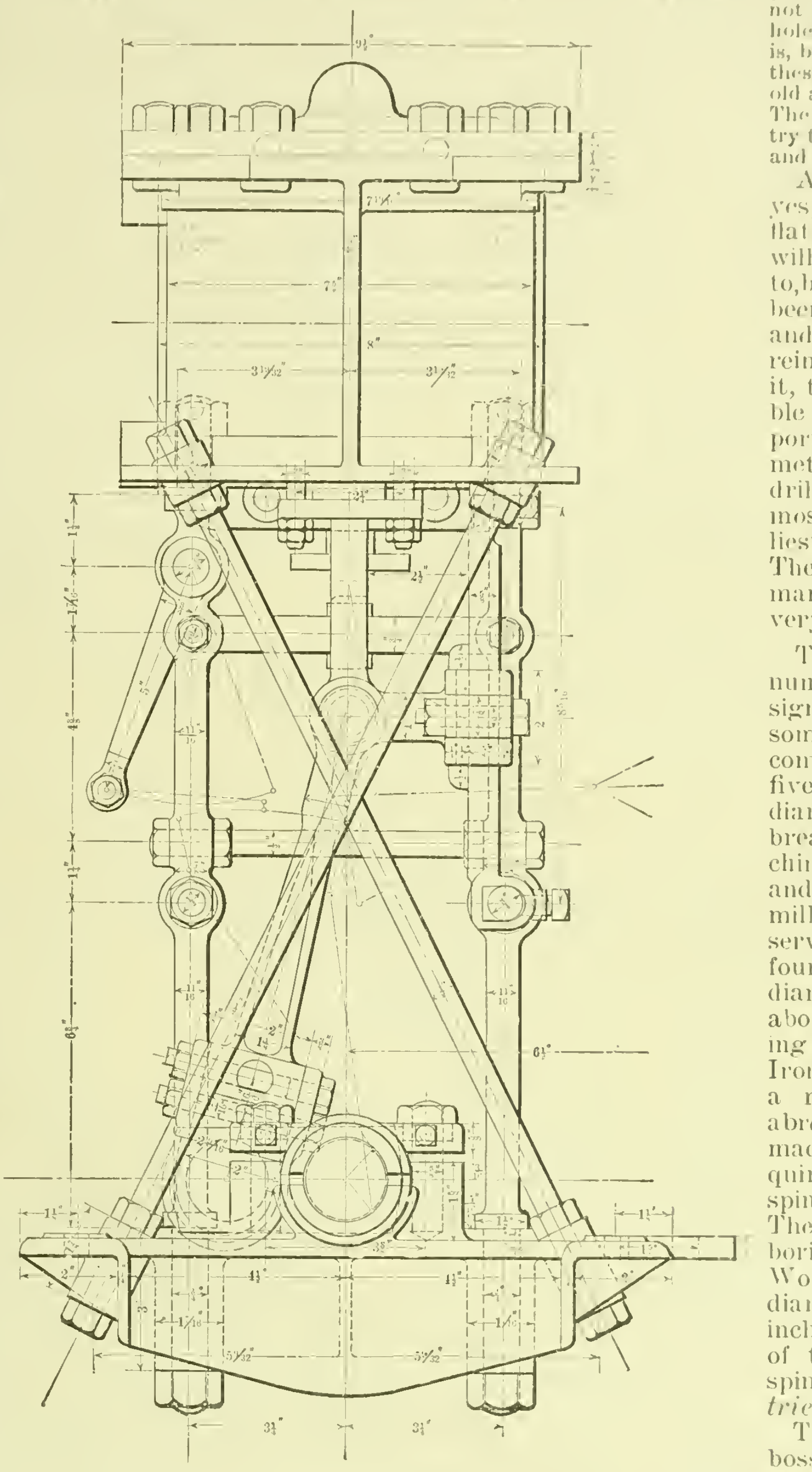
ALL the United States flags hitherto doing duty as union jacks and ensigns on board naval ships, or at army posts, have been called in, to give place to one whose blue field shall contain forty-two stars instead of thirty-eight. The stars are arranged in seven rows, six in a row.

◆

COMPOUND CONDENSING LAUNCH ENGINE No. 2.

BY THE BUREAU OF STEAM ENGINEERING, U. S. N.

THIS engraving shows low-pressure cylinder of the compound engine for steam launches; the high pressure was given in the previous issue. It will be observed that this engine is exceedingly light, and it would be policy for those who need them for rough and tumble work to add twenty-five per cent. to the working details.



◆

"A PECULIAR method of building a wall, which would apparently lead to a great uniformity of style, is practiced by the Romans. They erect two boards between which they pour a plaster of mud; the partitions are afterwards removed, when the material solidifies."

Well, a wall made out of a plaster of mud is not a good wall. It is made of concrete, not mud.

◆

PRICKLY heat, so called, is a terrible affliction, and can be cured by powdered sulphur pounced on with a soft cloth. It makes a man smell like a gasket, but it kills prickly heat.

FLAT DRILLS.

THE paragraph appended is cut from *Industries*, San Francisco, edited by a man who is one of the best mechanics in this or any other country, but he is constitutionally opposed to having any one say so. We don't care—we will continue to say it. Regarding the paragraph itself, here it is:

> "The old box chuck—may its shadow grow less—meant a block of wood bolted to a face plate and then bored out with the slide rest or hand tool to fit the "piece," which was then driven in. Next came the flat drill, either bare, or with blocks of wood riveted on the sides, to form an abutment. Oh, the holes we made in those old times! "Smooth as glass," says the pioneer—smooth!—yes smooth; but not uniform or straight. They were fine holes to look into, the same as a gun barrel is, but when you came to fit something in these holes, the sham was exposed. The old adage is, "all that glitters is not gold." The bore of a common gun is a "humbug;" try to pass a mandrel into or through it and see."

As to the chuck, and the gun, yes, in cheap guns, but as to the flat drill—well, maybe so. Doctors will disagree, not because they wish to, but because their experiences have been different. There are flat drills and flat drills; if not backed up, or reinforced by blocks screwed on to it, the flat drill is certainly not reliable for a true hole, but when supported by blocks and not too much metal left to be removed, the flat drill is, to our mind, the speediest, most exact, and altogether the loveliest tool to finish small bores with. There is no doubt, however, that a man who hates a flat drill can do very bad work with one.

◆

THERE is illustrated in a late number of the *Iron Age* a newly designed radial drilling machine with some good points, but when we come to the weight of more than five tons, and a spindle 2¼ inches diameter, one has to pause for breath. We have some drilling machines here with these small spindles, and geared to act like what the old millwright called a "backlash preserver." Why not make the spindle four times as large—4 inches in diameter instead of 2¼ inches, and above all place the differential gearing on the main spindle. The Union Iron Works some time ago ordered a radial drilling machine from abroad, because they could find none made in this country with the required power and rigidity in the spindle for boring in wrought-iron. The last machine for drilling and boring, erected at the Union Iron Works, has a spindle *nine inches* in diameter, and it will drill a hole 1 inch in diameter quite as well as one of the "fragile" machines with a spindle 2¼ inches diameter.—*Industries.*

The late Horatio Allen built the boss *vertical* drill in this country for the Old Novelty Works. This drill weighed something like 30 tons and had a spindle 12" diameter. It would handle a 2" drill easily, or bore out a core from the hub of a wrought-iron crank, leaving a hole 2' diameter. It was a very useful tool, but it was not a radial drill machine.

◆

THE old inquiry as to why a lobster is red when boiled, has been answered by *Science in the Family*. It says that when the lobster is immersed in boiling water, the blue pigment is destroyed, and the red pigment, which is very stable, appears in all its brilliancy.

We always thought it was because they were scalded.

◆

A HEADLINE in a morning contemporary, "edited by old soldiers," reads "One More Veteran Less." The writer possibly meant to say, "One Less Veteran More."—*Madison (Wis.) Journal.*

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

"BOOK ENGINEERS vs. PRACTICAL ENGINEERS."

Editors ENGINEER:

I would like you to advise me on the following subject: It is my ambition to become a mechanical engineer, and with this end in view I have been entered as a prospective student of a well-known Polytechnic Institute. Since then I have been informed that the only proper way for me to become a first-class engineer is to serve an apprenticeship in a machine shop, and work my way up to the top, and while an engineering school is well enough in its way, the majority of its graduates are what are popularly known as "kid glove" or "book" engineers. If I am going to be an engineer, I want to be a good one or none at all. Not only do I want to be a "book" engineer. but also a *practical* engineer and machinist. My love of engineering is no mere whim, it having been my highest ambition from early childhood; and with the hope of being an engineer some day I have spent my leisure time reading and studying mechanical books and papers, and drawing. Now, Mr. Editor, what shall I do to become an engineer?

Shall I go to the "Institute," or to a machine shop? If you will advise me as to the best course for me to follow, I will be extremely obliged to you. I have already taken up too much of your time, but before I close I will say that I have taken THE ENGINEER for three years, and take this opportunity to thank you for the many hours' pleasure it has afforded me. I take several papers of the kind, but THE ENGINEER is my favorite, and the only fault I can find with it is that it is not a weekly paper. With best wishes for the prosperity of THE ENGINEER, and thanking you for any advice you may give me, I remain,

St. Augustine, Fla. C. R. M.

[It is a pleasure to find a young man who earnestly desires to advance himself, and is seeking for light from those who have traveled the road he has set foot in. We will give him what aid we can. Unquestionably the shop first, and the school next. One aids and supplements the other. In the shop lie all the secrets of nature and natural laws, and in school books and in the words of professors the key to them. "Practical engineer," and "book engineer," are meaningless words, unless used in connection with some branch of the profession to which they specially apply. The practical engineer, so-called, is generally a man who uses the term apologetically; he is too lazy to study the cause from an effect, so he takes refuge in the assertion that he is no scholar, but he knows more about the steam engine than a professor does. As a matter of fact, he does not. He simply knows the sequence of parts in the engine, but when it comes to principles he disdains to acknowledge that there are any. It is all mechanical—the action of the engine is—and natural laws are ignored. Is it not a little curious that while the professor, who is a student, is fully aware of the value of practical experience, and tries to get all he can, the so-called practical man derides instruction and flouts at it? Let our young friend go into a good machine shop and learn the trade as well as he can; let him file, run a lathe and planer, and learn how to fit up work, not in a dilettanti or amateur fashion, but just as if that trade was all that stood between him and starvation, or the short commons of a wife and children. Let him fear to be discharged; let him be ambitious to be known as the best workman in the shop, and when he has done this for three or four years he can go to the Polytechnic and put in four years more. Given equal intelligence, no man will be his peer at the end of that time. When he hears false doctrines preached he can refute them and give reasons for his refutation.

It is no exaggeration to say that to be an engineer in the fullest sense of the word, is to be a great man in the eyes of the world. Fame and fortune are both to be his—in the days to come—for the rule-of-thumb day is going. Mechanical intuitions served us well when we had no better guide, but since the days of the pioneers in engineering in this country there have been schools founded, and we have had natural phenomena so clearly explained to us that we do not need to grope. The keys are in our hands.]

◆

STRAIGHT ANSWERS TO CROOKED QUESTIONS.

Editors ENGINEER:

Will you please answer through the columns of THE ENGINEER the following questions?

A.—Is or is not the back pressure in the high-pressure cylinder of a triple-expansion engine equal to the pressure in the intermediate cylinder? Why?

B.—How about the same in a compound engine?

C.—Given, a triple expansion engine; running at full speed, exhausting into the air; let the engine be stopped immediately at the closing of the valve of the high-pressure cylinder on the down stroke; now disconnect the steam-pipe and exhaust the steam on high-pressure piston into the air. Which way will the engine turn? Why?

D.—How about the same in a compound engine?

E.—Given, a triple-expansion engine; instead of steam let water be forced through it. Would any power be exerted beyond the power that forces the water?

F.—Given, a triple expansion engine with known back pressure on high-pressure cylinder; let this be disconnected from intermediate cylinder and exhaust into atmosphere. Would i. h. p. of this high-pressure cylinder be increased or decreased?

G.—Given, a triple-expansion engine of 300 i.h.p. with equal division of power on each crank; what would be the result if high-pressure cylinder be disconnected, and boiler connection be made to intermediate cylinder, turning engine into a compound? Would i.h p. remain $\frac{2}{3}$? Would it increase or decrease, everything else being equal? About how much?

H.—If a triple-expansion engine is more economical than a compound (?), why not have quadruple-expansion and 180 lbs. or more of steam pressure? I mean in vessels where such boilers are suitable.

I.—Beyond the reduction in condensation (?), the low terminal pressure, the triple division of power, what advantage is there in a triple-expansion engine? Is your answer *positively* reliable?

J.—What advantage have live cylinder engines, like those in the torpedo boat '*Cushing*,' over Thornycroft, Yarrow, or Schichau three-cylinder engines?

K.—Do you believe in steam jackets? Why? Would not jacketed steam be more efficient if used inside of cylinder? In triple-expansion engines, which cylinder (if any) would you jacket? Why?

What is your opinion regarding the results to be obtained from Professor Kennedy's research committee? Answering these questions will settle a dispute. I. M. H.

Boston, Mass

[*A.*—It is not quite equal, the lower temperature of medium pressure cylinder reducing the pressure there.

B.—Subject to the same laws.

C.—It will start in the opposite direction if the pressure on bottom of piston is greater than the resistance of the atmosphere and the friction if the engine.

D.—Subject to the same laws.

E.—It would be less.

F.—Would depend upon the initial pressure in high-pressure cylinder. Thus, for instance if it was 160 lbs., the h.p. would be increased.

G.—It would not, but would be decreased 20 per cent.

H.—It would be wise to do so.

I.—A saving of fuel. Yes, wholly reliable.

J.—It was done very likely in order to keep down the width of engine athwartship.

K.—Only in a low-speed engine, say up to twenty-live or thirty strokes per minute; above that the more frequent admission of steam into the cylinders makes it possible to dispense with the jacket and use the steam directly on the piston. Advocates of the steam jacket disagree as to which cylinder it should be applied to the most advantage.

L.—The experiments lack the completeness essential to make them valuable.]

◆

NO BAR TO HIM.

Editors ENGINEER:

Will you kindly tell me what branches of mechanical engineering a man would be able or unable to follow, if he be well fitted for the business, but obliged to wear glasses on account of near-sightedness? Is poor eyesight a serious impediment to one who wishes to be an engineer? By answering the above questions you would confer a great favor. My father takes THE ENGINEER, and I find it interesting and instructive. It is an excellent paper.

East Haven, Conn. I. N.

[To be near-sighted is certainly a disadvantage, but it is not an absolute bar to the profession of a mechanical engineer, and there is no branch of it our correspondent cannot follow. Some of the best machinists we have ever seen have been so near-sighted that they seemed to be testing their work with the nose. "Where there is a will there is a way," and nothing stops the determined man or boy.—EDS.]

◆

Here is a fine thing which you have never seen until this moment:

"'An engineer of Breslau, Germany, has constructed a tubular boiler which is claimed to be non-explosive. The danger of explosion is averted by means of automatic apertures. which slowly act when the steam exceeds a certain pressure, the water thereby being allowed to escape until the normal pressure is regained. The rapid water circulation in the vertically arranged tubes prevents incrustation and the deposit of mud."

Letting the water escape seems to be the German way of making a boiler non-explosive.

◆

A NEW element, named "damaria," is said to have been discovered in the crater of an extinct volcano in Damaraland. It is reported to have an atomic weight of only 0.5, or half that of hydrogen; and, therefore, it is the lightest known substance.

◆

ONE concern in this country makes 450 tons boiler tubes daily.

TO TEST ARMOR PLATES.

THE instructions sent by the Navy Department to the board of which Rear Admiral L. A. Kimberly is President, which is to meet at the Annapolis proving ground Aug. 15 for the trial of armor plates, provide for a very severe test. There has long been great rivalry between the makers of all steel and of compound plates, and latterly plates composed of an alloy of steel and nickel have entered into the competition. It was originally intended to test the American-made armor, and makers of steel were invited to submit plates, but no American firms were yet ready to turn out plates of the prescribed dimensions. Three foreign-made plates were therefore purchased. They are a compound of steel and iron plate, made by Cammel & Co., of Sheffield, England; an all-steel plate made by Schneider & Co., of Le Creusot, France, and an alloy nickel and steel plate by the same makers. Each plate is 8 feet high, 6 feet broad, and $10\frac{1}{2}$ inches thick. They are to be securely bolted to 36 inches of oak backing, and their composition is to be tested by chemical analysis. Each plate is then to be divided into squares by horizontal and vertical lines a foot apart. A six-inch breech-loading rifle and an eight-inch rifle are to be used, the former firing Holtzer armor-piercing shells of 100 pounds, and the latter Firth armor-piercing shells of 210 pounds each.

Each plate is first to receive a shot with a six-inch shell, with a velocity of 2,075 foot seconds, at the intersection of the second vertical with the second horizontal line, counting vertical lines from the right and horizontal lines from the bottom. A second six-inch shot with the same velocity will then be fired at the intersection of the fourth vertical and the second horizontal lines. Then the eight-inch gun is to be brought into action, and each plate is to receive an eight-inch shell, with a velocity of 1,850 foot seconds, at the intersection of the third vertical and the fifth horizontal lines. At the discretion of the department, the eight-inch gun may not be used, and, in that case, three more six-inch shots are to be fired, striking, respectively, at the intersections of the second vertical and sixth horizontal, and the third vertical and fourth horizontal lines.

The board may choose the exact point of impact for each shot after the first, but it must not vary more than one foot from the point fixed in their instructions. After each shot the plate is to be carefully examined, its exact condition noted, and photographs are to be taken of it. The condition of the plates and backing is not to be changed during the trial.

◆

AS an example of the special plea in argument, this extract from a controversy in a contemporary is not without interest:

> "The Doctor says that nature abhors a vacuum, and calls Brother "*Vacuum*" a fool, but like all the balance of the Doctor's sayings, this has not even the stability of a vacuum, as a vacuum is capable of being destroyed to give place to atmospheric pressure or what that pressure can force into it to replace it, but this statement is forever condemned to nothingness—there is no redemption for it. The fact is nature does not abhor a vacuum, but frequently creates it; and to very destructive purpose, as is demonstrated by the cyclone leaving in its path the tale of the power of the vacuum."

We suppose it would be difficult to convince the wrangler that there is anything funny in this.

◆

WHEN a storm is advancing the wind blows to meet it. Thus a wind blowing from the east or southeast indicates the approach of a storm from the west. When the storm center has passed, however, the wind changes and follows the storm. If a person has a good barometer and a good wind gauge, he can tell pretty correctly when a storm is coming. Without the instruments the clouds may be watched, and when seen to be moving rapidly from the southeast, and there are indications of the presence of moisture in the air, a storm is not far away.—*Unknown.*

DIRECTIONS FOR WORKING ALUMINUM.

The following directions are given by the Scovill Mfg. Co., Waterbury, Conn.:

A cubic inch of pure aluminum weighs approximately one-tenth of a pound avoirdupois, being about one-fourth the weight of an equal bulk of pure silver.

Pure aluminum can be rolled, drawn, spun, stamped, engraved, burnished, polished and soldered to the same extent and by the same processes as used on brass, with the following exceptions:

Annealing.—A very low and even temperature should be maintained in the muffle. Aluminum melts at about 1,300 deg. Fahrenheit—a very dark red. The inexperienced, therefore, cannot judge the proper annealing temperature by the eye alone, without danger of fusing the metal. When the metal has been heated enough to char the end of a pine stick, thus leaving a black mark in the wake of the stick as it is drawn across the metal, it is sufficiently annealed. The metal should then be withdrawn from the furnace and allowed to cool slowly in the air. For some work, such as stamping and drawing, it is sometimes better not to heat the metal so hot as to leave a dead black mark with the stick, but just enough to show a dark brown mark instead. Very thin sheets or wire can be annealed sufficiently for some purposes in boiling water.

Dipping and Pickling.—Remove the grease and dirt by dipping in benzine. To whiten aluminum, leaving on the surface a beautiful white matte, dip first in a strong, hot solution of potash, then rinse in water, and dip in undiluted nitric acid, 42 deg. Then wash in water, and dry as usual in hot sawdust.

Polishing.—Use fine white polishing composition or rouge, and a rag buff.

Burnishing.—Use a bloodstone or steel burnisher. For hand burnishing use either kerosene oil or a solution composed of two tablespoonfuls of ground borax dissolved in about a quart of hot water, with a few drops of ammonia added.

For lathe work the burnisher should wear upon the finger of his left hand a piece of Canton flannel, keeping it soaked with kerosene, and bringing it in contact with the metal, supplying a constant lubricant.

Very fine effects can be produced by first burnishing or polishing the metal and then stamping it in polished dies, showing unpolished figures in relief.

Scratch Brushing.—Polish or burnish the surface, and then use a fine steel scratch brush.

Soldering.—A special solder is necessary. Cleanse the metal from grease and dirt. Use for soldering fluid Venetian turpentine. Place the solder upon the metal with the Venetian turpentine, and heat gently in a blowpipe until the solder is melted. It will then be found to have fixed itself firmly to the aluminum.

Sand Castings.—Use open but very fine sand, and bake the mould. Large feeding gates should be provided, and the mould should be well vented. Pour the metal quickly, at a temperature but little above the melting point. Use either Taylor's or Dixon's plumbago crucibles.

Milling, Planing, and Turning.—Use plenty of oil to prevent the clogging of the tool and to make it cut smooth.

◆

If we needed any proof that man's mouth is automatic, and acts independently of his brains, we can find it in this queer paragraph:

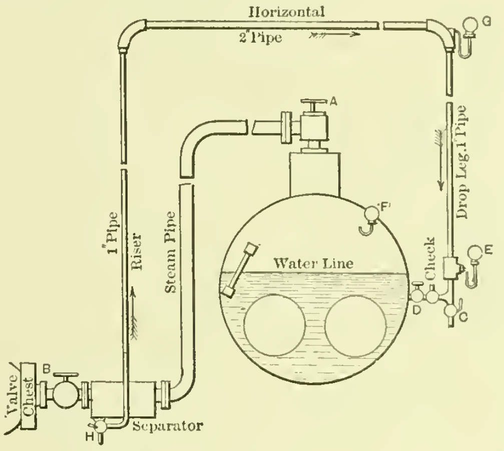
> "Every dollars worth of fireworks destroyed, represents just so much actual labor thrown away. While we persist in wasting labor we must have a supply. If we ever get to shorter hours than we are working at the present time we must economize and cease to destroy labor, and stop pandering to foolish fashion."

If the men who made the fireworks were paid for their labor, nothing was thrown away, and the firework-makers would not thank you for preventing fireworks from being burned.

THE STEAM LOOP.

In a recent issue we adverted briefly to the introduction of this apparatus for feeding boilers, or returning liquids under pressure, and in this issue present a diagram of it taken from *Engineering*, together with a description of its working. This system we think is already in use, and has been for some time, in the shops of the New Jersey Central Railroad at Elizabethport, where the condensation from an overhead system of steam heating pipes in the car shop is returned to the boilers similarly.

This steam loop will return water to a boiler situated at a higher level, without the intervention of pumps, injectors, or other motors. The water simply flows back just as if it were under the action of gravity, the only means of communication being a range of pipes. The action will be readily understood by the diagram, which shows a boiler connected by a pipe from the dome *A* to a steam engine *B*. In front of the engine is a separator which catches the water carried over by the steam, as well as that which condenses in the pipe. From the bottom of the separator there rises a pipe to a considerable elevation above the water line of the boiler; it then runs horizontally, and finally descends and enters the boiler at *D*. The water from the separator follows the course of the pipe, and flows into the boiler at a higher level than the separator. The reason of this will be readily seen. The steam pipe and the steam loop are all connected to the boiler, but of course there is a slight difference of pressure in them, the pressure falling a little the further the steam gets from the boiler. Let us suppose the pipes to be blown through at the cocks *H* and *C*, and these cocks then closed. Water will commence to collect in the separator and the pressure in the loop to fall by reason of condensation. The excess of pressure in the separator will immediately begin to drive the water up the riser, not in a solid body, but in several plugs, or plungers, which will follow each other at frequent intervals. As soon as these reach the top of the riser they will flow along the horinzontal pipe, which is of large diameter, and collect in the down pipe. Here the mass will remain until the head of water, plus the steam pressure above it, is sufficient to raise the check valve, when a part of the column will flow into the boiler. Usually a head of a few feet is sufficient to effect this, but if the pipes be very long it may require 20 feet or more. At the moment when the check valve lifts, the gauges at *E* and *F* will give the same reading, while the guage at *G* will show the steam pressure existing at that point. The water is thus returned to the boiler without loss of pressure, and almost without loss of heat. This is done continuously and automatically, the only care required being to blow through occasionally to remove the air.



◆

The largest greenback extant is worth $10,000, and there is only one such note in existence. Of $5,000 notes there are seven; but when you come down to the ordinary, everyday $1,000 note, there are millions.

◆

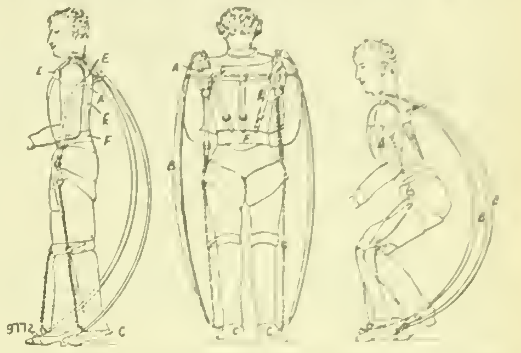
What's the matter with this one for a midsummer number?

A MECHANICAL BOUNCER.

Assuredly no man can add a cubit to his stature, but there are a great many who think he can add, not only to his stature, but to his strength as well. Man cannot add one ounce to his physical strength in any way, whatever mechanical advantage he may derive from the screw, lever, wheel, pulley, or what not is bought; paid for in time, the normal force of the man himself remains unchanged.

Here is a queer rig applied to a man by a Russian engineer, who has patented it, for reasons best known to himself:

The principal part of the apparatus consists of two elastic bow-shaped springs *B* of steel, the lower ends of which are connected to metal stirrups on the front part of the shoes *C*, while the upper ends are connected to two leather rings *A*, through which the arms of the person are inserted. These rings *A* are connected together across the chest and the back by means of bands *E* and *E*', and also to the belt *F* by means of straps *f*. In order to prevent the springs *B* from moving too much apart laterally, the band *E*' has sewn to it two straps or light wood bars *G*, having at their ends leather loops *g* embracing the springs *B*. The upper part of the body after each leap, in continuing to descend by virtue of its momentum, will bend the springs *B* to an extent dependent on their elasticity; immediately afterwards, however, the springs *B*, in endeavoring to straighten out again, will draw up the upper part of the body by means of the rings *A*, and will thereby almost force the person to make a second leap, and so on.



We fear that this mechanical bouncer will have very limited popularity.

◆

"People are as shy of electricity as they are of mines," said an engineer in the Electric Club lately, "and there is a substantial reason for it. The motor companies issue beautiful prospectuses, and the promises of electrical inventors and engineers are full blown, but a dispassionate view of the electric world, considered from a common sense standpoint, does not substantiate the theories of the enthusiasts. It does not make any difference whether fifty millions or five hundred millions are subscribed for pushing the present inventions, there is not one of them which has any great commercial value. A great many of them are beautiful toys and interesting playthings, but they do not go beyond that point. A man can make a steam engine for $1,000, and earn $10,000 a year with it. He can make an electric motor for the same amount, and it will make as much money, but where it costs $1,000 a year to run the steam engine, it will cost about $15,000 to operate the electric motor. There isn't much money in that sort of plan yet.

◆

About this time the papers are full of the beauties of this and that summer resort. It don't help a fellow a bit to read how to catch fish at Away-off, when he knows that all there is for him is a steady grind six days in the week. And that is all there is for ninety per cent. of the people in the world.—*American Machinist.*

Yes, dear friend, and it is a good thing that it is so. Have you ever reflected that landlords tell lies about fish biting? They bit last week, and they will bite next week, after you are gone, but they never bite in your week.

THE ENGINEER.

FORTNIGHTLY. - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

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VOL. XX. NEW YORK, JULY 19, 1890. No. 2.

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"CONDENSED MOMENTUM."

AN esteemed contemporary well and truly says that to many engineers the injector is a paradox, inasmuch as they cannot account for the contradictions of natural laws which seem to occur in its operation; we are unable to quote the exact language of our contemporary, for the paper is not at hand, but we think our recollection of its intent does not misrepresent it. After so sensible a remark as that quoted, it seems a pity to have spoiled it by another remark which, to our mind, is not so sensible, and to attempt to explain the action of the injector again by what is to us a new force.

Why so many explanations from all directions, if the injector is not paradoxical, and the mechanical riddle which has not yet been solved or reasonably accounted for? Professors of engineering and men of science have not disdained to treat of the injector and to attribute its powers to various forces, and others have written about it in other directions, but it has been left to our contemporary to discover that this curious instrument is indebted to condensed momentum for its working.. We do not wish to satirize our contemporary, or ridicule its views upon any point, but we would like to know what condensed momentum is. Condensed milk, concentrated ammonia, compressed carbonic acid gas, compressed oxygen—these are all familiar in the arts, but we fancy no one but our contemporary ever conceived of condensed momentum. If there really is such a force, how is it generated? Momentum is, we believe, the force of a body in motion, and is expressed in terms of the square of the velocity of the mass, or more exactly, the mass multiplied by the square of its velocity. This should, we think, afford a definite amount of momentum, a quart of it, to express it in quantity. Now, how this can be condensed into a pint and give us any more force we are really at a loss to understand. We seem all the time to be gibing and girding at our contemporary, but we deny any such intention, and if our language bears this construction upon its face it is only by reason of our mental confusion and distress in trying to comprehend what condensed momentum can possibly be. If we may express our thoughts, we will say that we do not believe there is any such force as condensed momentum, but if we say this we seem to be selfishly smashing our contemporary's opinion of the action of the injector, for this new (to us) force is the reason for its explaining the injector all over again, and solving the paradox off-hand.

Far be it from us to break anyone's images. Let others destroy the illusions of youth and ruthlessly tear down explanations which do not explain. We will not; but no one can object to our hesitation to accept condensed momentum just yet. Expressed in sentences, there is no condensed momentum. The injector does not condense any. Our contemporary never saw any, and it has no formula by which it can express the condensation of momentum.

Regarding the injector itself, it is not under discussion, but we are one of those to whom it is a paradox. In it the lesser force is the greater. A jet of steam can leave the boiler, travel a given distance, greater or less, come in contact with a stream of cold water, and drive this water into the boiler against a pressure many times greater than its own original pressure. That is to say, the steam in leaving the boiler re enters the boiler with the feed water against the boiler pressure on the check-valve. The area of the steam pipe is 1″, let us say, but the area of the check is $1\frac{1}{2}'' +$ the area of the top, say 2″ area exposed to boiler pressure. Does it not seem a paradox that these things should be so? It does to us, and until we know more than we do, we shall set condensed momentum, vacuum (a vacuum in a pipe outside of a boiler forcing water into it! That is fine?), kinetic energy, induced currents, *et al*, outside of the possible forces which cause the injector to feed a boiler.

REFORM THE SYSTEM.

ANOTHER daily paper of this city, the *Herald*, to wit, has undertaken the task of "showing up" the methods of the Bureau of Steamboat Inspection in this city, and, in connection with it, the Supervising Inspector General himself, the head of the service at Washington. The *Herald* says some hard things which are true, but they have all been said before. Saying them over again does not materially change the situation; neither do personal attacks. That the methods employed to examine engineers, to say nothing of other seafaring men, could be much improved there is not the least doubt. We have had many complaints in person from engineers who have been rudely treated, domineered over by persons clothed in a little brief authority, and there are many other cases of which we know nothing. All this is entirely unnecessary and out of place. Inspectors are to serve the people; they are not masters in any sense, and the sooner they realize their position the better it will be for all concerned. The whole trouble lies in the fact that the office of steamboat inspection is used for political purposes. It is employed to reward politicians and their friends for party services, and is not run in the interests of engineers, the general public, or steam vessel owners. The *Herald* proposes that the Bureau of Steamboat Inspection should be put in charge of the Government, but unless we are mistaken it is now virtually conducted by the Government; it certainly is not administered by private parties.

In former years we have expended a great deal of zeal and enthusiasm, mingled with hope of a change for the better, but we have lived to feel that there will not be any change until the politician ceases to be a huckster of party merchandise and becomes a patriot.

MACHINE-MADE ICE.

UNDOUBTEDLY the time is rapidly approaching when communities will no longer depend upon nature for ice. This substance has become a prime necessity of civilized life, and that we should be at the mercy of the seasons for an unlimited supply is anomalous. Ice-making machinery has been so perfected that it is possible to produce it at much less cost than natural ice can be cut and housed for. Machine-made ice is already housed, so to speak, for it is made on the place where it is sold. It is asserted that artificial ice can be produced for 50 cents per ton, but this, we presume, refers only to large plants. Ice-making machines are so generally used, that one type of them, which uses ammonia, has caused such a demand for the article that it has risen greatly in price. The chief source of supply for commercial ammonia is the waste liquor of gas works, and as not much gas is used in summer, not much liquor is made, hence the stringency mentioned above.

Machine-made ice is "good for the trade." Ice factories will give employment to engineers and machinists, and will support a good many families.

CONCERNING HOLIDAYS.

ARE there too many legal holidays? We should say there are plenty, at the least. Holidays have to be paid for in many ways not patent on the face of the matter, and the question is whether they are beneficial or prejudicial to the interests of all concerned. National festivals which have historic associations cannot be dispensed with; they are a part of our national life, but the practice of tacking on twenty-four hours prior to and subsequent to them, seems to obtain to a very marked degree in later years. To-day it is hardly worth while to do much, because to-morrow we are not going to do anything, and the day after the holiday we cannot do anything because we have already done too much. The results of this kind of reasoning (!) are that everyone is out of his course when work must go on in earnest, and losses are incurred which are very hard to bear for many. Work accumulates in bulk, orders are delayed, and to get ahead, to make up for lost time, everyone increases their exertions. "All work and no play makes Jack a dull boy" without doubt, but too much play is bad for both Jack and his master.

◆

LICENSING LOCOMOTIVE ENGINEERS.

It would seem to be about time for locomotive engineers to pass an examination in their calling and be licensed, the same as other engineers are. We read daily of delayed trains on account of broken side-rods and slipped eccentrics, which are the merest trifles as derangements, and should not delay a train ten minutes. Side-rods, indeed, have been taken down and the engine underway again inside of six minutes. We believe it to be a fact that very few locomotive engineers can reset a slipped eccentric, when not only they, but every fireman, should be able to do it by the mere sense of feeling, and in the dark. A blind man can set a slipped eccentric on a locomotive and have her cut square, too.

On locomotives the eccentrics always stand toward the crank pin. Look at the clock; when the crank pin is on 12 the eccentrics stand at figure 10 and figure 2, widest parts on the figures. This is where there is a rocker-arm, as in all standard engines.

Here is an item which speaks volumes:

"The 8.18 train, Friday evening, was delayed *several hours* by the slipping of an eccentric on the engine (No. 27). A special was made up at this station to convey the crowd to stations further north."

This was on the Housatonic Railroad. Railroad managers ought to get out diagrams and post them in every cab.

◆

LATEST LEGAL DECISIONS ON TRADE.

Reported for The Engineer.

[We shall until further notice publish the latest decisions in courts of last resort upon topics of general interest to our readers. From these decisions they will be able to judge in a measure of their own chances in similar cases.]

Liability of Master for Using Defective Machinery.—A laborer on a railroad whose duty it was to give signals for hoisting and lowering stone, was injured by the breaking of a rope which allowed the derrick to go to pieces. The rope broke because of the negligence of the foreman of the gang, and the company is liable for the injury, as the foreman is a vice-principal and not a fellow-servant.—*Union Pac. Ry. Co.* v. *Fray, Supreme Court of Kansas, 23 Pac. Rep.* 1039.

Collision Caused by Mutual Fault.—A steamer brought suit against the owners of a sailing vessel and the owners of her cargo for damages caused by a collision. On the trial it appeared that the fault was mutual. The costs were apportioned under the rules of the court, and the cargo owners can recover of the steamer only one-half of his costs, but must look to his co-libelant for the other half.—*The Wyanoke District Court of the United States, Southern District of New York, 42 Fed. Rep.* 80.

Salvage for Towing Vessel in Distress into Harbor.—A steamer coming into harbor sighted a vessel in distress and towed her to a place of safety. She had been separated from a tow that she was part of by high seas. In an action to recover salvage, the owners of the disabled ship set up that she did not ask to be towed, and that she was not towed to a place of safety; this was disproved upon the trial, and the court allowed extra salvage on account of the character of the attempted defense.—*The Atbany United States District Court of Massachusetts, 42 Fed. Rep.* 64.

Implied Renewal of Contract of Employment.—Where a person has been employed by another for a definite term at fixed wages, if the services are continued after the expiration of the term in the same business, it is presumed that the continued services are rendered upon the same terms; but this presumption may be overcome by proof of a new contract, or circumstances which show that the old contract has been changed. The power of revoking an agency, pending a current year's business, no doubt exists, but the right to revoke it without sufficient cause does not exist, and a wrongful revocation leaves the principal liable to make reparation. —*Standard Oit Co.* v. *Gilbert, Supreme Court of Georgia, 11 S. E. Rep.* 481.

Injury of Servant from Defective Appliances.—Where a servant caused the injury of a fellow-servant by means of defective appliances furnished for the common use of both, and the condition of which was known to the employer, the employer will be liable for the damages thus caused. —*Burns* v. *Ocean S. S. Co., Supreme Court of Georgia, 11 S. E. Rep.* 493.

Marine Insurance—Barratry. The policy written by the Portland Lloyds covers barratry of the mariners, but not of the master, when the insured is an owner of the vessel. The master of a ship, who is part owner, may be guilty of barratry towards his co-owners, so as to avoid a policy of insurance, written in their favor, that does not cover the risk of barratry of the master. A marine policy covers negligence of the master and mariners. The testimony of an experienced seaman relative to proper measures which should be taken to prevent stranding is competent as bearing upon the proper navigation of a vessel, a question wholly for the jury to consider.—*Hutchins* v. *Ford, Supreme Judieiat Court of Maine.* 19 *At. Rep.* 832

Injury to Child.—An employer who orders dangerous machinery oiled by a child of such tender years that he is incapable of properly understanding the nature of the danger to which he was subjected, is liable for injuries he may receive while so employed, if he use due care according to his capacity. The fact that the child had received general instructions from the master's foreman to oil the machinery, and that he was injured while attempting to oil it, sufficiently shows that he was acting within his duty and under the orders of his employer.—*Hinckley* v. *Horazdowsky, Supreme Court of Illinois, 24 N. E. Rep.* 421.

Responsibility of Servants in Dangerous Employment.—An employee who is engaged about machinery and whose hand is crushed while brushing cogwheels cannot recover for his injury from his employer, even though he was inexperienced and had not been instructed concerning the danger, as the danger incurred was plainly apparent and incidental to the employment, and therefore assumed by the employee. The fact that coverings for such cogwheels were not provided by the employer, though they might have been used, and were used in similar machinery about the mill, does not impute negligence to the employer, inasmuch as the cogs themselves were not dangerous in the absence of negligence of those about them.—*Tousend* v. *Langles, Circuit Court of the United States, Eastern District of Louisiana, 41 Fed. Rep.* 919.

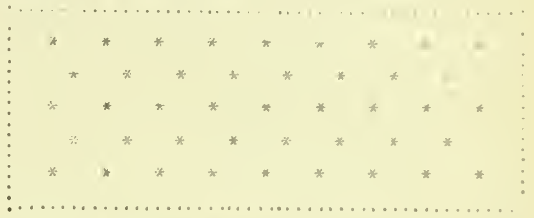
Damages on Account of Boiler Explosion.—Where a boiler explosion caused the plaintiff to shut down his mill and remain idle for some time, the rental value of the mill during the length that it remained idle on account of the explosion is a proper element of damages.—*Sinker* v. *Kidder, Supreme Court of Indiana, 24 N. E. Rep.* 341.

Personal Injuries—Contributory Negligence.—The cover of a ship's hatchway was left on or off as occasion demanded. A seaman who undertook to sit down on the cover without looking to see if it were on or off, is guilty of contributory negligence and cannot recover.—*The Sir Gamet Wolsety, United States District Court, Eastern District of New York, 41 Fed. Rep.* 896.

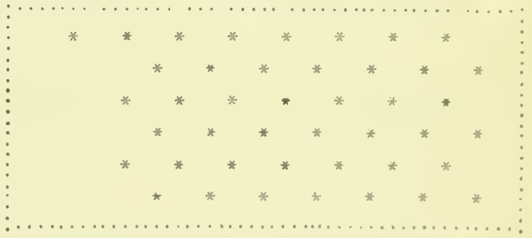
Collision of Vessels from Dragging Anchor.—A barge ran inside the Delaware breakwater during a storm and anchored near another barge; after a time the last one to arrive began to drag her anchor, and was only secured when so close to the other barge as to render a collision inevitable when the tide turned. It was possible for her to change her position, therefore she is liable for the damage caused by their collision. —*The Wallace United States District Court, Eastern District of New York, 41 Fed. Rep.* 894.

THE FLAG.

The admission of Idaho into the Union on July 3 necessitated a re-arrangement of the stars in the American flag. The law provides that the change in the field of the flag shall be made each Independence Day, to include the new States admitted during the previous year. The field had recently been altered to represent forty-two States, increased to this number by the admission of North and South Dakota, Washington, and Montana. A re-arrangement will immediately be effected. The delay is caused by certain formal proceedings incident on an official agreement of the army and navy to the arrangement of the stars "on a blue field." The new arrangement will be more symmetrical than the one of last year. There will be live rows, the first, third, and fifth of nine stars each, and the second and fourth rows of eight stars each. The new constellation, as it will appear on the corrected flag, will be as follows:



The Navy Department has also prepared a design for the new field. It incorporates the present arrangement of six rows of seven stars each, and adds the additional star to the upper left-hand corner. The idea of symmetry is to be obtained eventually by the addition of another star to the lower row. This arrangement will be:



The Quartermaster-General of the Army has charge, among other duties, of the flags belonging to the service. There are something like three hundred flags in use all over the country, at posts, barracks, regimental headquarters, and army buildings.

The flags which have been discarded are stored at the War Department until the accumulation becomes cumbersome, when the lot is destroyed by fire. By long established custom the Department refuses to ditribute official flags outside of the regular service. There has been discussion now and then on the bestowal of old flags on G. A. R. posts and civic military bodies, but the Department's refusal of all requests is based on the patriotic reason that the flag which is signalized, as it were, by official use, is worthy no less a disposition than consumption by fire. The refusals, however, afford the Department no opportunity for favoritism, and relieve the officials of the exercise of the fine discrimination necessary to an impartial distribution.—*N. Y. Sun.*

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Squaring valves, setting valves, and running them over all, mean the same thing exactly. When a mechanic is sent to do this work he may only have to move a blade on the strap, or he may have to move all the eccentrics—what he finds it necessary to do does not change the name of the job, nor make the object of his work any other than that of getting the valves square.—*Locomotive Engineer.*

To the above we take the liberty to add that squaring valves means that they shall open both ports to the same extent when driven by the eccentric.

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We have received three subscriptions from San Pedro, Cal., signed "No. 49." The papers have been sent, but we do not know whom to send an acknowledgement of the money to. All letters should be signed by the senders of them.

Foreign and Domestic Trade Literature.

THE ADAPTATION OF THE STEAM MACHINERY IN MARINE CONSTRUCTION. No. 3.

WHEN blowers are used, the rate of combustion can be very greatly increased, and special calculations must be made. In modern compound engines with forced draught, 8, 10, and in exceptional cases as many as 20 h.p. have been procured for each square foot of grate, but the highest performance cannot be calculated upon for regular work. For illustration, going back to the results with natural draught, if there be but 100 pounds of coal consumed per square foot of draught area, or, for average proportions, 12½ pounds per square foot of grate, and there be 600 i.h.p. to provide for; if the steam is to be used in engines requiring 20 lbs. of water horse-power per hour in actual practice, and the same is to be generated in boilers which in ordinary practice evaporate but 8½ pounds under actual conditions, it will be seen that there must be consumed 2 353 pounds of coal per i.h.p. per hour, or for 600 h.p. 1,412 pounds per hour, on which basis there would be required 113 square feet of grate, or 56½ square feet in each of two boilers. If each boiler be provided with three circular furnaces, 3 feet in diameter, or for each boiler 9 feet aggregate width, the length of grates should be a trifle over 6 feet. As has been explained, it is more important, however, to get sufficient draught area to burn 1,412 pounds of coal per hour, which, at the rate of 100 pounds per square foot of draught area, would require 7.06 square feet of draught area in each boiler. There will be appended to this lecture, when published, a table showing the cross areas of boiler tubes for draught and the heating surfaces per foot of length of different sizes of standard boiler tubes, from which, selecting the cross area of the size of tube to be used, the number of tubes required will be easily ascertained. In selecting the size of tubes, practical considerations are of greatest importance. On rivers, in the waters of which there may be considerable mud and silt, it is customary, as previously stated, to use quite large tubes, even those of 6 inches and 8 inches in diameter, which may be called flues. About the harbors and on the coasts, it has been usual to employ tubes of 4 inches diameter, but at sea and to some extent in harbor work, it has become customary to reduce the size of the tubes, and thereby decrease the length of the boilers. This has been the case particularly as higher pressures were employed, so that now 3 inch tubes are very common in marine work, and there are numbers of instances where tubes as small as 2½ inches in diameter have been used. The same cross area for draught cannot as readily be obtained in a boiler shell of given diameter with small tubes as with large, but the difference is not great. While the small tubes decrease the length and weight of a boiler, they also diminish the disengaging surfaces for steam and the steam space, so that the diameters for a given power are necessarily somewhat in excess of those in which large tubes are employed. If then we assume in the case in hand that in each of the two boilers we are to use 3 inch tubes, we find by table that the cross area of a 3 inch tube is 0.042 square foot, so that there will be required 168 tubes of that diameter for each boiler. It then becomes necessary to make a drawing in cross section of the boiler to ascertain what sized shell will be required to contain this number of tubes. The three furnaces are first to be arranged in the bottom of the shell, separated from each other and from the shell 4 to 5 inches, the smaller dimension being sufficient if care be taken in the construction of the boiler. The tubes can then be arranged in horizontal and vertical rows above. The exact arrangement varies with different builders. In boilers of 8 or 9 feet diameter they can be distributed equally between the water spaces at the sides, but in larger boilers it is better to leave a central water space three or four times the ordinary width between tubes, in addition to those at the sides, for circulation. The writer's practice is to make the side spaces 9 inches in the clear, so that a small man can work his way down outside the tubes to the spandrel spaces at the sides of the furnaces and clean off any deposits. Access between and above the furnaces is generally obtained by manholes in the front head. The furnace tubes are at present generally made corrugated, in accordance with the Montgomery and Fox patents, which are now regularly manufactured at the Continental Iron Works, Greenpoint, instead of being imported as formerly.

In fixing the sizes of the engines, it is well at first to determine the piston displacement per minute which corresponds to a given power under the conditions of steam pressure and expansion in the cylinder. (By "piston displacement" is meant the area in feet multiplied by the double stroke in feet and the number of revolutions per minute.) In doing this it should be borne in mind that the low pressure cylinder of a compound engine, whether it have two cylinders, three or more, is the one to be used in making the calculations for displacement, entirely independent of the sizes of the other cylinders, as the slightest consideration of the subject will show that since the effective pressure in the larger cylinder is practically the back pressure in the smaller, the larger cylinder would, if supplied with the steam direct, give the same power with the same degree of expansion as all the cylinders together, or in practice, on account of the losses of pressure between the cylinders a trifle more. The only difference would be in the distribution of the forces throughout the revolution and in the strains on the working parts. It is, therefore, an error to start with the small cylinder in cylinder computations; the large cylinder must be made right for the power and other considerations determine the size of the small one.

BOILER TUBES.

Outside Diameter.	Internal Cross Area.	External Surface per Foot of Length.
Inches.	Square Feet.	Square Feet.
1	0.003993	0.2618
1¼	0.006722	0.3272
1½	0.009646	0.3927
1¾	0.01327	0.4581
2	0.01787	0.5236
2¼	0.02315	0.5891
2½	0.02835	0.6545
2¾	0.03491	0.7200
3	0.04215	0.7854
3¼	0.04942	0.8508
3½	0.05797	0.9163
3¾	0.06720	0.9·18
4	0.07590	1.0472
4½	0.09757	1.1781
5	0.1205	1.3090
6	0.1754	1.5708
7	0.2426	1.8326
8	0.3208	2.0944
9	0.4072	2.3562
10	0.5016	2.6180

The mean pressure, therefore, in all cases, should preliminarily be "referred to the large cylinder," which simply means that there is to be added to the mean pressure in the large cylinder the mean pressure in the several smaller cylinders, multiplied for each by its size relative to the large one. For instance, if the area of the large cylinder be considered unity, and that of the small cylinder of a compound engine be ¼ of that of the large, and there be a mean pressure of 50 lbs. in the small cylinder, this 50 lbs. multiplied by the relative size, viz., ¼, gives 12½ lbs. as the equivalent mean pressure in the large cylinder, which added to that actually existing in the large cylinder, say 12½ lbs, makes 25 lbs mean pressure "referred to large cylinder." The mean pressure referred to the large cylinder used in most of the low pressure engines and in the earlier forms of compound engines was from 18 to 20 lbs. The writer raised this 25 lbs. in designing the engines for the revenue steamer '*Rush*' in 1873, before compound engines were introduced in the English or American naval steamers, and thereby obtained good results, for the reason that the mean temperature of the metal of the cylinder was raised, and there was less cylinder condensation than when more expansion was attempted.

It will be found, assuming any sizes desired, that the horse-power with 25 pounds means pressure, in any given case, may be obtained by multiplying the piston development by 0.1091, say ordinarily by 0.11, when, of course, the power for a mean pressure of 30 pounds may be obtained by adding ⅕, or the power for a mean pressure of 20 pounds in the cylinder by substracting ⅕, and so on, in an evident manner. Conversely, if the horse-power be determined in advance, the first step is to obtain the piston development, which for a mean pressure of 25 pounds is done by multiplying the horse-power desired by 9.168.

In general, the displacement equals 229.2 times the power divided by the mean pressure. Having obtained the development and decided the number of revolutions per minute from the size of screw or other considerations, by dividing the development by the proposed number of revolutions per minute the result will be the development per revolution which, divided by twice the proposed stroke in feet, will give the area of the piston in square feet, from which the diameter may be readily obtained and reduced to inches. If this diameter be too large or too small, the stroke or revolutions may be varied to bring the engines to an ordinary proportion. By this method, the roundabout system of calculating the power with assumed dimensions, and then modifying some dimension until the proposed power is procured by a system of approximation, is almost entirely avoided. It may here be observed that this preliminary calculation is an important one. It may spoil the good working of an engine if the cylinder comes out an odd inch in diameter to make it an even one; for instance, to make it 30 inches when the calculation gives 29 inches. If a 30 inch engine be desirable for the reason that patterns are available, then for a given boiler power the displacement should be maintained by increasing the pitch of the propeller. It is too commonly the case that an engineer, after making very careful calculations of the size of the engine, considers that he will get a little more expansion, and adds to the size of the cylinders. The extreme of this kind of designing is that an elephant must be fed to the work of a horse, so if the first premises were correct, they should be adhered to, as any material departure therefrom will make it hard for the boiler to furnish steam, and cause loss instead of gain. This has been determined in engines of all classes, operating mills as well as driving the propellers of steamers, and is a common experience even on locomotives. The problem reaches its perfection in the design of high speed engines for the Atlantic service, where the difference of trips requiring several days is counted in minutes. Modern designers are very careful not to get the engines too large to work off the steam, and in the construction of the latest great ocean racers the error was on the other side, as it was found, when the cut-offs on small cylinders were set at the point desired, the engines would not work off all the steam the boilers would make, so that not only on the Inman steamers '*City of New York*' and '*City of Paris,*' but on the new steamer '*Teutonic,*' of the White Star Line, the propellers have had to be made with less surface, to permit the engines to run a little faster, so that they could develop the power which could be furnished by the boilers.

In technically "getting out of an engine" all that is possible, the throttle valves should be wide open and the supply be controlled entirely by the cut-off gear. When it is necessary to shut the throttle partially to keep up the pressure, it is an evidence at once that the engines and boilers are not proportioned to work together. Recurring to our previous illustration, multiplying 600, the proposed horse-power, by 9.168 gives 5,501 cubic feet as the displacement, with 25 pounds mean pressure, or 3,667 cubic feet for a mean pressure referred to a large cylinder of 1½ times 25, or 37½ pounds. If the power is to be developed in a twin screw vessel, the displacement for the higher mean pressure should be 1,834 cubic feet for each engine. If the stroke be fixed at 20 inches, the double stroke would be 40 inches or 3⅓ feet. If we fix the speed of the engine at 150 revolutions per minute, the piston speed would be 3⅓ times 150 or 500 feet, and the displacement (1,834 cubic feet), divided by the piston speed (500 feet), gives 3 668 square feet as the area of the large cylinder, corresponding very nearly to 26 inches in diameter. The proper size of the small cylinder depends upon a variety of conditions. If it be desired, from simplicity, to use the link motion valve gear on both engines, the engineers will rarely cut off at less than ⅝ stroke in the small cylinder, so to obtain an expansion of six times, the proportional area of cylinders must be 1 to 3.75 or 1 to 4, though 1 to 3 would be better if the main valve be properly constructed, so that the engine works smoothly when cutting off shorter. A better distribution is secured by using an independent cut-off on the small cylinder and obtaining more expansion in that cylinder, when it will be found necessary to make the small cylinder say $\frac{4}{10}$ the area of the large for pressures of 70 pounds to 80 pounds, and about ⅓ the area of the large for pressures of 100 to 120 pounds. With engines up to 20 inches diameter of cylinder, plain slide valves can be used to advantage on both cylinders. For larger cylinders, the throw of the main valves becomes so great that it is desirable to use a double-ported valve on the large cylinder and continue to use a single valve on the small until it gets above 24 inches in diameter for steam pressures of 80 pounds, and up to say 20 inches in diameter for higher steam pressures. The present practice is to use slide valves on the large cylinders in all cases, although for a time it was modified by using from two to four piston valves. Piston valves are now employed almost universally on the small cylinders of triple-compound engines, and generally on the intermediate cylinders.

In designing a vessel, it is necessary, as at first intimated, to know preliminarily the aggregate weight of the several portions of the machinery, which are so compactly arranged that they can be considered as independent masses, so that the machinery as a whole may be placed in the vessel in a position to balance the hull on the water, so that it will "trim" properly or draw the required amount of water both forward and aft. In doing this it is customary to consider as one mass the boiler, which is supposed to be concentrated at its center of gravity a little nearer the front than the rear, on account of the weight of the steam chimney; the engines without the line shafting as another mass supposed to be concentrated at the center of the engine; the line shafting, as another mass supposed to be concentrated at the center of its length; and the stern shaft, with the stern pipe, stuffing box, and stern bearing, as another mass supposed to be concentrated at the common center of gravity a little abaft the center, on account of the increased weight of the stern bearing; and, finally, the screw propeller as still another mass concentrated at its center. These several masses are to be multiplied by the distance of the center of gravity of each from any fixed point, for instance, the after edge of the stern post (or, to avoid minus signs, the center of propeller or even the bow of the vessel), and the sum of these moments divided by the sum of the gross weights, which will give the distance from the point of reference at which the center of gravity of the several masses is located. The center of gravity of the hull may in a similar manner be determined by ascertaining the weight of different cross sections, taking the moments of the same from a fixed point and dividing by the total weight as before. The weight of the machinery as a whole, considered concentrated at its center of gravity, and the weight of the hull as a whole, considered concentrated at its center of gravity, may then be multiplied by their distances from a fixed point and divided by the gross weights of the hull and machinery, thereby giving the position of the center of gravity of the vessel as a whole, which, if located at the center of displacement of the hull when in proper trim (by shifting the position of the machinery as a whole or of other weights), will cause the vessel to trim properly. There is frequently great carelessness in this part of the work, as some so-called naval constructors try to average up the weight of the hull by figuring simply a central cross section, without taking into consideration the increased weight of the stern of most vessels. Frequently also there is carelessness in distributing the several items of weight in the machinery; but errors in draught and trim occur more frequently from the fact that the vessel is designed piecemeal, the spaces assigned arbitrarily without consideration of the weights to be carried, and the machinery put in where it is convenient, so that the result in the end is quite unsatisfactory, frequently resulting in causing the vessel to be "down at the head" and occasionally at the stern, and requiring that, for the whole life of the vessel, considerable quantity of ballast be carried to "trim ship." Too frequently the weights are not all known in advance, and one thing after another is added until, as a final result, the vessel draws much more water than was at first anticipated. Such defects occur both in merchant and naval vessels, but can be prevented by making originally a complete plan of all the principal parts and a list of all the articles to be put in the vessel, writing opposite each article its estimated weight, when the results of errors on individual items will be less than if the same were left entirely out of consideration.

(*To be continued.*)

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COMPOUND LOCOMOTIVES.*

WHAT gains have followed compounding? (*a*) It has achieved a saving in the fuel burnt averaging 18 per cent. at reasonable boiler pressures, with encouraging possibilities of further improvement in pressure and in fuel and water economy. (*b*) It has lessened the amount of water (dead weight) to be hauled, so that (*c*) the tender and its load are materially reduced in weight. (*d*) It has increased the possibilities of speed far beyond 60 miles per hour, without unduly straining the motion, frames, axles, or axle boxes of the engine. (*e*) It has increased the haulage power at full speed, or, in other words, has increased the continuous h.p. developed per given weight of engine and boiler. (*f*) In some classes has increased the starting power. (*g*) It has materially lessened the slide valve friction per h.p. developed. (*h*) It has equalized or distributed the turning force on the crank-pin, over a longer portion of its path, which, of course, tends to lengthen the repair life of the engine. (*i*) In the two-cylinder type it has decreased the oil consumption, and has even done so in the Woolfe four-cylinder engine. (*j*) Its smoother and steadier draught on the fire is favorable to the combustion of all kinds of soft coal, and the sparks thrown being smaller and less in number, it lessens the risk to property from destruction by fire. (*k*) These advantages and economies are gained without having to *improve* the man handling the engine, less being left to his discretion (or careless indifference) than in the simple engine. (*l*) Valve motion, of every locomotive type, can be used in its best working and most effective position. (*m*) A wider elasticity in locomotive design is permitted; as, if desired, side rods can be dispensed with, or articulated engines of 100 tons weight, with independent trucks, used for sharp curves on mountain service, as suggested by Mallet and Brunner. One such engine of 80 long tons is now under construction.

What losses are said to have followed compounding? (*a*) In some particular types, as actually proportioned, a loss in starting power of from 15 to 20 per cent. However, loss of power in starting cannot be said to be a defect in the principle of compounding. (*b*) An increase in the number of parts. They are few and plain in the two-cylinder engine, entailing little outlay in first cost or in repair. (*c*) A possible, but, this committee thinks, not probable increase in the cost of repairs to the boiler, per pound of fuel burnt, if higher pressures are used. Positive information on this point is difficult to obtain. (*d*) An increased cost of repairs to the engine per mile run. This item is not yet large enough to be measurable, after three years' continuous service in the plainer forms of the two-cylinder compounds. (*e*) A larger percentage of failures on the road due to greater complication and size of parts. (*f*) Increased reciprocating weights on one side, either not balanced, and so increasing the deflection of the engine, or, if approximately balanced, the balance weight doing injury to the road bed, etc. The two last sections seem to be pure suppositions, which, after search, we find no evidence to sustain. (*g*) Want of variability or adaptability to wide extremes in speed, and to amount of work to be performed; so that a large compound does not work as cheaply when hauling light loads, or running without load, as a single engine does.

It is not proved that a compound, working properly throttled, that is, with steam wire-drawn, may not have actually, as she theoretically has, a wide and economical adaptability. So that if the compound, like any other motor, be not as economical when exerting low power as when exerting full power, it probably will use less steam than the simple engine of same weight, working under similar conditions of light haulage duty.

However, the one thing certain about "American condition" is that no larger portion of our motive power does run lightly loaded, and until we have a wider experimental experience, it is not recommended that all locomotives, doing branch and local light service, be built compound.

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THE BOTTOM OF THE OCEAN.

PROF. HERRMANN FOL proposes the work of exploring the bottom of the Mediterranean by going down under waters himself. He has constructed a special outfit for his yacht, and has also made a peculiar kind of diving suit and air pump for the purpose.

By this new system he thinks that it will be possible to descend to great depths without injury to the ears or the breathing apparatus, and with no danger of vertigo. The greatest inconvenience experienced is found in coming up from great depths to points where the effects of the compression at a depth of about one hundred feet are gradually lessened, and it is this trouble that has limited diving to a depth of about one hundred and ten feet. When the water is transparent and the sun brilliant, the bottom can be seen at a depth of twenty-five yards from the deck of a vessel. In order to see through undisturbed water a scuttle closed by a thick glass plate has been put through the bottom of the yacht, by means of which the bottom can be plainly seen in spite of the waves. The appearance is as though it were perfectly flat, as there are no shadows cast, the light coming from above. In reality, however, when one goes down in the diving suit, he finds the bottom bristling with rocks and hollowed with valleys. The lighting at the bottom is like that of a room without windows, receiving its light through glass in the ceiling. To the one under the water light appears in the shape of a cone opened at about an angle of sixty-two degrees, outside of which everything is in shadow. Looking up while in the clear space the sky can be seen, and very often the clouds can be distinguished.

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* Report of a Committee of the American Railway Master Mechanics' Association at the Old Point Comfort Meeting, June 17.

The intensity of the light under the water diminishes with great rapidity. At about ninety feet one sees very much less, and when the sun approaches the horizon, and the rays get much more oblique, it seems as though night had come. Horizontally, at 100 feet depth, a rock cannot be made out at a greater distance than twenty-five feet. Generally speaking, at a greater depth than thirty feet one cannot distinguish things under the conditions that ordinarily obtain. This will account for the inability to see their way on the part of those who attempt to navigate submarine boats. As soon as an object is seen it is so close that there is not time to steer clear of it. Navigation in deep waters can only be in directions that have already been examined and found clear, which naturally confines submarine boats within very narrow limits.

Submarine life, such as fish, lobsters, etc., have the habit at the very first apprehension of danger of darting rapidly away and of stopping equally quick. They seem to understand that a very few yards will get them beyond the vision of their enemy. The shading of the water varies from blue to greenish. Objects at a depth of thirty feet take a blue tinge and at from seventy-five to ninety feet the light is such a deep blue that objects of a red shade appear black. When one returns quickly to the surface with his eyes accustomed to the peculiar under-water bluish light, the aerial landscape, following the laws of contrast of colors, seems reddish. The fact of the blue rays of light penetrating so much further than those of any other color renders it possible to bring photography to aid the submarine explorer in his investigation as to the real depth that light does succeed in making its way.

The greatest trouble experienced in the use of M. Fol's apparatus comes from the swells which penetrate to quite a depth and cause him to go swinging about from one spot to another, but, in spite of this, he has faith in his methods, and counts upon astonishing the scientific world with his discoveries before the close of the year.

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WHAT DOES A STEAM HORSE-POWER COST?

No. 4.

Necessary Factors for Comparison.

Coal per one i.h.p. per hour.
Coast of coal per ton.
Pounds of water per one i.h.p. actual.
Evaporation per pound of coal.
Initial steam-pressure, absolute.
Terminal steam-pressure, absolute.
I.h.p.
Calorimetric conditions at engine and boiler.

Conclusions Necessary.

Cost of one i.h.p. one hour for coal, in mills.
Cost of one i.h.p. twenty-four hours for coal, in cents.
Cost of total load per hour for coal.
Pounds of coal per hour and twenty-four hours, in cents.
Pounds of water per hour and twenty-four hours.

All the above give the only correct comparisons between one and another steam plant as to dollars and cents. Pounds of coal, without cost of coal per ton, means nothing so far as the cost of a horse-power per hour, day or year goes, and the relative cost of a horse-power in dollars and cents in different localities amounts to nothing beyond an assertion, unless we know the actual number of pounds of water evaporated by a pound of coal, and then we must know for comparison or for fact the amount of water carried over in the steam, for the boiler gets credit for an evaporation that is entirely fictitious, in case a large amount of water is present in the steam, and this is so frequent that no result is worth the time spent that does not embrace all the factors in the first part of No. 4. The calorimeter is at once the most reliable and unreliable factor in the whole, and the so-called "modifications," "improved" and variously-termed traps, called calorimeters, are only to mislead those who suppose a good wooden barrel and scale of no use. The facts are simply expressed, the old-fashioned barrel is as honest and reliable as any, if honestly used, and in a great degree more reliable than any of the "improved" traps so much paraded. Where small quantities are used a small error is a too large factor of percentage; in my own practice 300 or 350 pounds of water are used, to which exactly 30 or 35 pounds are added. This makes quick work, and does not need any calculus or long formulæ to get results.

Conclusions necessary call for a moment's explanation. Any result for an hour is of no value. Conditions of the atmosphere make a great difference in evaporation, and the amount of moisture in the air is an element of more importance than usually given. Coal burned in ten hours has no place in my results, but the full coal for a week is taken, including "boilers over Sunday" for fire (as is required by the factory mutual mill insurance companies), and all the coal used; in this way all the facts come out.

Some "evaporative" tests of an hour or two on a 500 h.p. engine may be interesting or amusing, but they cannot be reliable, if we wish to compare the cost of a horse-power for a week or year.

WHAT DOES A STEAM HORSE-POWER COST?—NO. 5.

Coal per i.h.p. per hour, pounds...	2.28	6.05
Cost of coal per ton..................	$2.90	$2.25
Pounds of water per i.h.p. actual.	16.84	47.99
Evaporation per pound of coal....	10.31	7.92
Initial steam pressure, absolute...	83.6	94.6
Terminal pressure, absolute.......	8.71	17.2
I.h.p....................................	151	159
Cost of one i.h.p. one hour (coal) mills................................	2.59	6.077
Cost of one i.h.p. twenty-four hours (coal), cents........................	6.216	14.58+
Cost per hour (coal), total load (third line above), cents.........	39.+	96.62
Pounds of coal per hour for load..	344	961.95
Pounds of coal per twenty-four hours per h.p........................	54.72	145.20
Pounds of water per twenty-four hours for one horse-power......	404.16	1,151.76
Water in steam by calorimeter at boiler, per cent......................	2.16	2.26
Water in steam by calorimeter at engine.................................	3.04	21.16
Comparative cost of one h.p. same time....................................	$1.00	$2.4775
Actual cost of one h.p. one year, 308 days, 10 hours.....................	$7.98	$18.72

In this we have a Corliss condensing engine and an ancient throttling slide-valve, under free exhaust, one factor, about the same horse-power. In studying the columns of comparative cost, item by item, some interesting facts appear: Coal per i.h.p., and cost per ton, water used per horse-power per hour, all show a change, in which some items are best one way or the other. The cost of horse-power per year of 308 days, 10 hours each, would make a difference of $1,074 only in each 100 h.p. plan, working on the conditions of the right-hand columns over one under the conditions of the left-hand column, the engine of smaller horse-power paying sixty-five cents per ton more for coal, and using steam of lower initial pressure, but showing better evaporative power and better calorimetric results.

The engine of left-hand column was put up under my direction in 1883. The other one is in Pennsylvania.

WHAT DOES A STEAM POWER COST?—NO. 6.

Coal in pounds per hour, per horse-power..................................	1.57	7.7027
Cost of coal per ton..................	$4.35	$2.25
Cost of coal per horse-power per hour, in mills........................	3.4	8.1174
Actual water consumption per horse-power per hour in pounds	13.71	59.618
Pounds of water evaporated per pound of coal........................	10.34	7.92
Steam pressure per gauge.......	130.	80.
Steam pressure, absolute.........	144.696	94.696
Terminal pressure, absolute......	5.619	70
Initial pressure, absolute.........	146.341	82
I.h.p....................................	138.056	249
Cost of one i.h.p. for twenty-four hours, in cents.....................	8.166	19.48
Cost of one i.h.p. for 308 days of ten hours each......................	$10.48	$24.98
Coal per i.h.p. for twenty-four hours, in pounds.......................	37.68	184.86
Water per i.h.p. for twenty-four hours, in pounds.....................	329.004	1430.83
Water in steam per calorimeter, at engine, per cent..................	2.31	21.14
Water in steam per calorimeter, at boiler, per cent...................	1.74	1.87
Duty for twelve months from log for 100 pounds coal...........	113,439,331	19,068,000
Comparative duty....................	5.949	1

Table No. 6, left-hand column, is from the Pawtucket pumping engine in 1879. The column at the right-hand is a pumping engine in Pennsylvania, new in 1887 or 1888. Notice there is a difference of $2.10 in the cost of coal per ton; one engine has over 100 h.p. more than the other; great difference in terminal pressure, as well as initial; one engine using 13.7, the other 59.6 pounds of water per i.h.p., the amount of coal per i.h p. being 4.9 times as much in one case as in the other; the boilers varying very *slightly* in the amount of water present in the steam at the boiler, very *largely* in that at the engine. Yet in total result the Corliss engine horse-power costs only $10.48 for 3,080 hours, the other engine $24.98.

(To be continued.)

THE BOILERMAKERS' CONVENTION.

The American Boilermakers' Association held a convention in this city July 1, 2 and 3, at the Park Avenue Hotel. The association is composed of boiler manufacturers, and its membership extends over this country and Canada. It was formed at Pittsburg in April, 1889, for the purpose of affording boilermakers means of consultation, and of bringing about united action on matters of common interest. The objects which the association has before it are:

> To establish such standard for materials and workmanship as will insure uniform excellence of construction of all American boilers, and thus secure safety to the lives and property of all communities where boilers are used, and to procure the passage of laws making the manufacture, sale, or use of inferior materials criminal offenses.
>
> To concert such measures and take such action as shall be for the interest and advantage of its members especially.
>
> To procure and furnish to its members statistics of the trade, domestic and foreign, and
>
> To take such action as shall from time to time be deemed advisable regarding the regulation of prices and production.

The convention is the second held by the association since its organization. About seventy-five were in attendance. After the President had delivered a short address, the Secretary, A. T. Douthett, made a report.

It was inferred from this report that the American Boilermakers' Association had become a very strong organization. Reference was made to the great interest manifesting in the association by all of the leading boilermakers of America. There are 128 manufacturers members of the association.

A report of the committee on manheads and manholes was presented, but the convention declined to receive it because it had not the endorsement of the full committee. The committee was discharged and a new committee was appointed, consisting of Messrs. Raynal, Matthews, and Mitchell.

A report on materials and tests was received and adopted. It dealt with rivets, bolts, and valves, and furnished specifications for boilermakers to work under. The object being to secure uniformity and the best possible methods of construction.

Considerable discussion was provoked by the report of the committee on uniformity in state inspection laws. The report was not a formal one, but was designed to give an idea of the progress that the committee had made toward the foundation of a method for securing uniform legislation throughout the States touching the inspection of boilers. It was advised that the committee should, before adjournment, adopt some resolutions embodying its ideas of what was needed in the way of legislation, and suggesting the best way to get it.

Mr. A. H. Raynal, in the course of the discussion on the report, said that the correspondence between the committee and the

Secretaries of State throughout the country indicated that there was not that interest in the matter under consideration that one would naturally expect to find. "One Secretary of State," said Mr. Raynal, "ought to come to New York and get elected alderman. He wrote the committee that if it would send him $7 he would tell the committee what it wanted to know."

It was thought best to appoint a new committee to consider the matter of boiler inspection, and the chair named as that committee Messrs. Marshall, Dundan, Raynal, Lovegrove, Cunningham, Hopkins, and Conery. The committee was instructed to consult with the gentlemen representing the Navy and Treasury Department before completing its report.

No other report being ready, interest seemed to center in the discussion of the question: "What should be done to raise the standard of workmen in boilermaking establishments?" Almost every member of the convention seemed to have his own peculiar notions as to how this question should be answered, and it was at length decided to appoint a special committee to consider the question. The chair named as that committee Messrs. Brownell, Dundan, Hopkins, McCormick, Hammond, Leonard, Marshall and Raynal.

The committee on uniform boiler inspection reported a series of resolutions, which were adopted. The resolutions declare that the association is strongly in favor of the framing and adoption of uniform laws for boiler inspection to hold throughout the territory covered by the association; that it favors a national boiler inspection law if it may be had without violation of the Constitution; that, in any event, the association desires that none except competent boilermakers shall be appointed as boiler inspectors, and that no person shall be appointed until after he has satisfactorily undergone examination by a competent board of examiners.

The matter of apprenticeship was disposed of by instructing the committee on apprenticeship to further consider the subject, and report at the next regular convention.

The committee on insurance was authorized to go on and organize a boiler insurance company, and generally to do what would be necessary to put the company upon its feet, with the understanding that all of the committee's acts be subject to supervision by a board of twelve trustees to be appointed by the association.

◆

THE principal thing respecting the average of dynamo bearings is that they are not well arranged for high speed. In wood planing machines nothing is thought of driving a spindle two inches in diameter at 1,500 feet per minute, or twice as fast as dynamos usually run. The bearings have in two or three years past been much improved, but require to be longer, pivoted, and arranged for fountain oiling. Most will say in respect to pivoting the bearings, that it is not necessary for rigid frames, and that the alignment is complete without it. This is good theory, but is not good practice. There is no way of convincing one of the need for pivoted bearings except by demonstration, that is, by "feeling" such a bearing when the shaft is running. Perfect alignment, or equal pressure over the surface of a bearing, which is practically the same thing, calls for adjustment within a ten-thousandth of an inch. The slightest want of balance, the strain of a belt, or an unequal bearing of a frame, will cause deflection far beyond this, so that pivoting is the only way to secure a perfect bearing for a dynamo as it is in other cases. A good many makers are adopting this method.—*Industries.*

◆

THE Watertown *Times* makes the suggestion that water put in a porous earthen jar, and set in a shaded place, becomes as cool as people ought to drink.

It does in India, but not here; the dew-point is too high.

LIGHTNING CONDUCTORS, FROM A MODERN POINT OF VIEW. No. 2.

By Prof. Oliver J. Lodge.

THE only limit is reached when the heat generated by the current fuses the wire, or runs the risk of fusing it. But in so far as oscillations are prevented, the mean square of current strength on which its heating power depends is diminished. Accordingly, a fairly thick iron wire runs no great risk of being melted. Its outer skin may, indeed, be considerably heated, for these sudden currents keep entirely to the outer skin, penetrating only a fraction of a millimetre into iron, and they make this skin intensely hot. But the central core keeps cool until conduction has time to act, and, consequently, unless the wire is so thin as to be bodily deflagrated by the discharge, its continuity is not likely to be interrupted. Thickness of wire is thus more needed in order to resist ordinary deterioration by chemical processes of the atmosphere than for any other reason.

But the liability to intense heating of the outer skin should not be forgotten, and care should be taken not to take the wire past readily inflammable substances for that reason. For instance, it would be madness to depend on Harris' notion that a lightning conductor through a barrel of gunpowder was perfectly safe, especially if said conductor were an iron wire or rod.

In the old days a lightning conductor of one or two hundred ohms resistance was considered dangerously obstructive, but the impedance really offered by the best conductor that ever was made to these sudden currents is much more like 1,000 ohms. A column of copper a foot thick may easily offer this obstruction, and the resistance of any reasonably good earth connection becomes negligible by comparison. A mere wire of copper or iron has an impedance not greatly more than a thick rod, and the difference between the impedance of copper and iron is not worth noticing.

But although, in respect of obstructing a flash, copper and iron and all other metals are on an approximate equality; it is far otherwise with their resistances, on which their powers of dissipating energy into heat depend. It is generally supposed that iron resists seven times more than copper of equal section, and so it does steady currents, but to these sudden flashes its resistance is often 100 times as great as copper, by reason of its magnetic properties. This statement is quite reconcilable with the previous statement that in the matter of total obstruction there is very little to choose between them; the apparent paradox is explicable by the knowledge that rapidly varying currents are conveyed by the outer skin only of their conductor, and that the outer skin available in the case of magnetic metals is much thinner than in the case of non-magnetic.

Questions about shape of cross-section are rather barren. Thin tape is electrically better than round rod, but better than either is a bundle of detached and well-separated wires —for instance, a set of four, one down each cardinal point of a chimney, but it is easy to overestimate the advantage of large surface as opposed to solid contents of a conductor. The problem is not a purely electrical one—it is rather mixed. The central portion or core of a solid rod is electrically neutral, but chemically and thermally and mechanically it may be very efficient. It confers permanence and strength; and the more electrically neutral it is, the less likely is it to be melted. Its skin may be gradually rusted and dissolved off, or it may be suddenly blistered off by a flash; but the tenacity of the cool and solid interior holds the thing together, and enables it to withstand many flashes more. Very thin ribbon or mutiple wire, though electrically meritorious, is deficient in these commonplace advantages

There were two functions attributed to high conducting power in the old days: first the overpowering of all other paths to earth; second, the avoidance of destruction by heat. The first we have seen to be fallacious; on the second a few more explanations can be made. In so far as fusion by simple current strength is the thing dreaded, it must be noticed that a good conductor has no great advantage over a bad conductor. It is a thing known to junior classes that when a given current has to be conveyed less heat is developed in a good conductor, but that when an electromotive force is the given magnitude, less heat is developed in a bad conductor. The lightning problem is neither of these, but it has quite as much relationship to the second as to the first. There is a given store of energy to be got rid of, and accordingly the heat ultimately generated is a fixed quantity. But the rise of temperature caused by that heat will be less in proportion as the production of it is slow; and though by sudden discharge a quantity of the energy can be made to take the radiant form, and spread itself a great distance before final conversion into heat, instead of concentrating itself on the conductor, yet this cannot be thought an advantage. For, just as in the old days a lightning rod was expected to protect the neighborhood at its own expense by conveying the whole of a given charge to earth, so now it must be expected to concentrate energy as far as possible on itself, and reduce it to a quiet thermal form at once, instead of, by defect of resistance and over-violent radiation, insisting on every other metalic mass in its neighborhood taking part in the dissipation of energy.

The fact that an iron wire, such as No. 5 or even No. 8 B. W. G., is electrically sufficient for all ordinary flashes, and that resistence is not a thing to be objected to, renders a reasonable amount of protection for a dwelling-house much cheaper than it was when a half-inch copper rod or tape was thought necessary.

A recognition of all the dangers to which a struck neighborhood is liable doubtless prevents our feeling of confidence from being absolute in any simple system of dwelling-house protection: but at the same time an amount of protection superior to what has been in reality supplied in the past is attainable now at a far less outlay; while, for an expenditure comparable in amount to that at present bestowed, but quite otherwise distributed, a very adequate system of conductors can be erected.

Only one difficulty do I see. In coal-burning towns, galvanized iron wire is, I fear, not very durable, and renewal expenditure is always unpleasant. It is quite possible that some alloy or coating able to avoid this objection will be forthcoming, now that inventors may know that the problem is a chemical one, and that high conductivity is unnecessary.—*Industries.*

◆

To reduce skin friction the screws of the '*San Francisco,*' U. S. N., built at the Union Iron Works in that city, are finished all over. They are "worked out" says *Industries*, the same as a shaft is turned or any true form is finished. Every inch of area is worked over. The "wheel" is mounted on an adjustable axis, and sliding, sealed rods are projected from a plane parallel to rotation in ten concentric arcs: spots are chipped away until the points of these rods indicate the true helical plane of the screw. These points are near together, and after the ten rows are complete the spots are then connected by chipping groves between them, after which, with these points as a guide, the whole surface is chipped, filed and finished as bright as a door knob. Those acquainted with the nature of maganese bronze and how it cuts or files, can appreciate this job.

◆

WHAT has become of the French gentleman who made the big locomotive with drivers 14′ in diameter hung under the boiler? The engine does not seem to do so well after it is built as it did in the papers before it was built.

TRADE NOTES.

William McDonald, a well-known marine engineer of this city, is chief of the '*Sandy Hook*' this year, with John Haverty as first assistant. The '*Sandy Hook*' is a flyer, and William and John will keep her on the wing.

* * *

The Narragansett Electric Light Co., of Providence, R. I., have contracted with the Babcock & Wilcox Co. for 1,120 h.p. additional boilers, and also for the reconstruction of their present Moore boilers into the Babcock & Wilcox system.

* * *

J. Beavor Webb, the yacht designer, has given a contract for a large steam yacht to Neafie & Levy, Philadelphia. The owner's name is withheld. The yacht will be of steel, 240 feet over all, 204 feet on the water line, 13 feet draught, and 27 feet beam. She will cost about $300,000 when completed, and will be one of the finest steam yachts afloat.

* * *

James Mullen is trying to force the Brotherhood of Stationary Engineers, Association No. 1 of New York, to restore him to membership. He was expelled on a charge of having tried to secure a fellow-member's place for himself. Judge Beach recently decided that the association should show cause why Mullen should not be made a member again.

* * *

The Barnard Engineering Company, 15 Cortlandt Street, N. Y., have issued an interesting pamphlet on the subject of *The Economy and Efficiency of Steam Heating at Atmospheric Pressure*, which is not only interesting but timely. At this season heating systems are overhauled and looked into, and all contemplating the adoption of steam heating should send for this pamphlet.

* * *

The Blake Manufacturing Company, of Boston, Mass., builders of steam pumps under the Blake & Knowles patent, has been sold to an English syndicate at a price, said to be $3,000,000. The Blake and Knowles interests were consolidated over ten years ago. The negotiations for the sale have been in progress for some time, and the sale is due to the desire of George F. Blake to retire from business.

* * *

The steamship '*Algonquin*,' built in Yoker, England, was employed on the lakes in the carriage of freight. She was fitted with six Purves patent ribbed furnaces, made by John Brown & Co. The partial collapsing of these furnaces on August 10 last, made it necessary to withdraw the '*Algonquin*' from service, and six corrugated furnaces, made by the Continental Iron Works, Brooklyn, N. Y., have replaced those of the Brown pattern, and the vessel is now in service.

* * *

The hygrodeik is a patented instrument for graphically denoting the amount of moisture in the atmosphere. It consists of a scale, round the face of which a finger travels. The finger is centered on a short pin, the other end has a crank on it. To the extremity of this one end of a hair is fixed, the other end being fastened to a pillar. As the temperature or humidity in the shed varies the hair expands or contracts, and as the weight is always arranged to preserve it in tension the indicator finger is moved across the scale.

* *

On the morning of June 24, when the '*Benguella*' Ss. was in mid-ocean, the shaft broke. The engines could not be stopped immediately, and the forward end of the broken shaft beat about the shaft tunnel and tore a big hole through the plates of the ship. The water rushed in, drove the stokers on deck and put out the fires. Her head was kept to the sea, and the crew was ordered to provision and lower the lifeboats. The passengers and crew were safely in the boats and clear of the ship within fifteen minutes. The boats drifted about for several hours, when they were sighted by the bark '*Mariannina*,' which picked up the castaways.

* * *

Judge Brown, United States District Court, has decided that John E. Jardine was entitled to $27.50 pay for acting as quartermaster on the Atlas Line steamship '*Adirondack*.' On the trip from Carthagena, April 18, Jardine took a small monkey aboard. It died, but when New York was reached Jardine was charged $5 for freight, and the amount was held from money due him. Judge Brown says that shipowners have a claim against anyone who makes himself a party to a bill of lading, but that Jardine did not occupy this position and must be allowed his full claim for wages, with no deduction on account of the monkey.

* * *

The competitive test of coil boilers for the coast defense vessel '*Monterey*,' now being built at the Union Iron Works, San Francisco, has been decided in favor of Charles Ward, of Charleston, West Va. William Cowles, of New York, was Mr. Ward's only competitor. The report of the board, of which Chief Engineer Loring was President, was very favorable to both boilers, but found that the Ward boiler was best adapted in certain minor details for the '*Monterey's*' construction. According to the board's report, the four Ward boilers with which the '*Monterey*' will be supplied will furnish steam for 4,500 indicated horse power at 20 lbs. of steam per horse power per hour.

* * *

Owing to some derangement of signals, the '*Vesuvius*', U. S. N., ran into the dock at the Navy Yard, Brooklyn. Although the vessel had a speed of only two or three knots, the bow struck with sufficient force to cut clean through four pine timbers, 14 inches square, lying side by side. The wood was entirely sound, and cut as clean as though sawed, with no trace of splintering. After cutting through the timbers she ran into an immense pile of granite behind; but, strange to say, the plates adjoining the point of impact are in no way disturbed, save for a slight spot about six inches square on the starboard bow. The cause of the collision was the disarrangement of the electric signal system between the deck and the engine room, to which is due also the stranding of the vessel at the mouth of the Delaware a few weeks ago.

* * *

The official report of the board appointed to try the cruiser '*Philadelphia*,' says that the average speed during four hours was 19,678 knots per hour, and that the engines and boilers worked most satisfactorily. The board estimates that the ship, under forced draught, ran about one hundred miles. At the end of the trial the machinery and boilers were in good condition, only one slight accident having occurred in the arrangements for oiling the machinery. The board reports that the vessel is sufficiently strong to carry its proposed armament, equipments, coal, stores, and machinery, and that the machinery, including engines, boilers, and appurtenances, is strong and well built. In conclusion, the report says that the vibration of the hull during the trial was at no time more than would be expected in a vessel of this type. The '*Philadelphia*' has earned for her contractors $135,000 in speed premiums, being at the rate of $50,000 for each quarter knot in excess of 19 knots per hour.

* * *

The great demand for artificial ice machines, and the necessity for furnishing long coils of pipe to be used in their construction, has furnished a new and extensive field for the electric pipe welding machines. The difficulty of welding pipe by the old methods is that, unless the joints are perfect, there is an escape of ammonia vapor which renders them practically useless. It is found that by electric welding these joints are perfect, and lengths of 400 to 500 feet of homogeneous pipe can be made without difficulty. The electric welds stand bending either hot or cold, and by this process it also becomes practicable to frequently test the coils as they are being bent, and correct any defects as the process of bending goes on. It is also found that by electric welding the pipe can be brought to any degree of heat that is necessary, and special bends made without the introduction of U joints or couplings, as heretofore has been the practice. Long lengths of pipe, with joints which can be relied upon, can thus be laid in the streets of the various cities for conveying cold from the refrigeration apparatus to consumers.

◆

Now and then I see a man at work who botches everything he touches. Not long ago I was in a car shop where one of these unmechanical mechanics was employed. My attention was attracted to his peculiar manner of doing things, and I soon saw that he was a man in the wrong place. He lacked the mechanical hand and eye. When he tried to drive a nail, failure followed. It really seemed that he could split a heavy sill with a shingle nail, while the man beside him could drive a railroad spike through a veneer without checking it. The unmechanical mechanic was destroying nearly everything he handled. All he seemed to be able to do was to sweep out, and even at that work he was likely to do some mischief. When a man of this sort has stuck to mechanical work long enough to prove his inability to do it, he ought to have sense enough to understand that he is at the wrong job.—*Unknown.*

◆

The dangerous explosions of gas which are constantly occurring in mines are easily prevented by the system recently introduced by Thomas Shaw, M. E., of Philadelphia, Pa., Chief Inspector of Mines in Ohio R. M. Hazeltine says of its workings:

"I have witnessed this plant in a large mine which generates large quantities of gas, where it has been in successful operation for over eleven months, and I believe that it is practical, and a guard over the miners and the mines, and when fully inaugurated that it will be the means of saving many lives and a large amount of property. It should be thoroughly examined by all parties interested in mines and mining.

A PREPOSTEROUS TALE.

A little time ago I was going from Chicago to Cleveland. Three or four men struck up an acquaintance, as they struck up a light in the smoking-room. Each gave a little biography of his recent life. "I have been to Chicago," said Mr. A. B., "to collect some conscience money. A good many years ago I made an invention. It was stolen from me by some Chicago people. I spent much money in trying to get my rights, and did not get them. Two weeks ago I received a letter from the house in Chicago which had been manufacturing and selling my invention, saying, that if I would come to Chicago I should hear of something to my interest. I went to the place appointed, and met a gentleman who said:

"'You are Mr. A. B.?'

"'Yes.'"

"'Our house has for many years been making and selling an invention of yours. I have recently become a Christian. I know I have done wrong, and I want now to do all I can to right that wrong. Will you please say how much money we shall pay you for the wrong we have done you?' I thanked him, and said I wanted time to reflect. I took the time, and gave an answer. Turning to the cashier, the gentleman said: 'Make out a check for so much,' a sum double the amount I had named. That check was certified, and I now have it in my pocket. I am glad to tell this incident for many reasons, one of which is that it tends to answer the charge that is frequently made that being a Christian makes no difference with one's busines habits."—*A Clergyman in the Chicago Advance.*

Well, our comment is that "Christian" is a very elastic word.

◆

CLUB RATES FOR 1890.

In former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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◆

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Engineers' Gazette, London	1.50	3.50
National Car Builder	1.00	2.75
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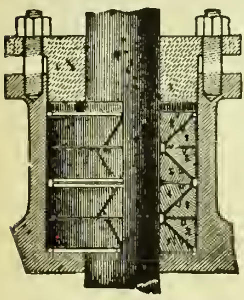

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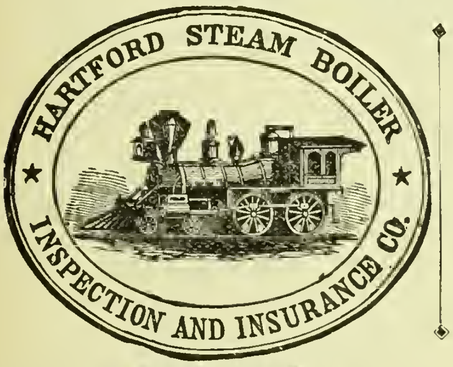

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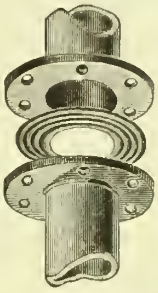

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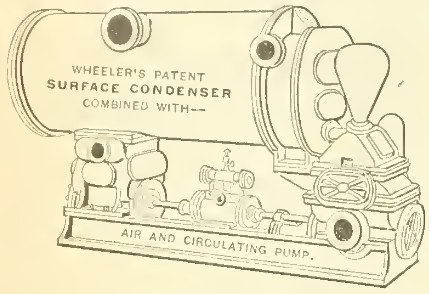
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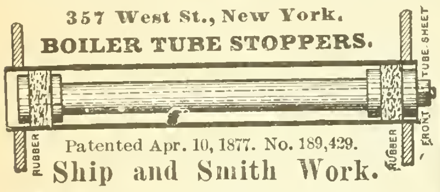

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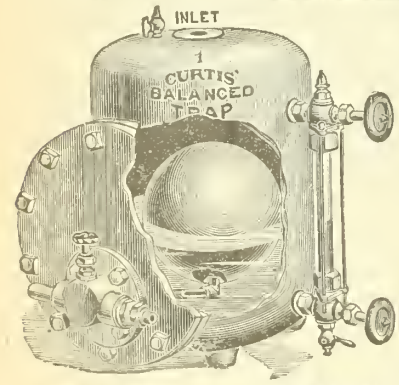

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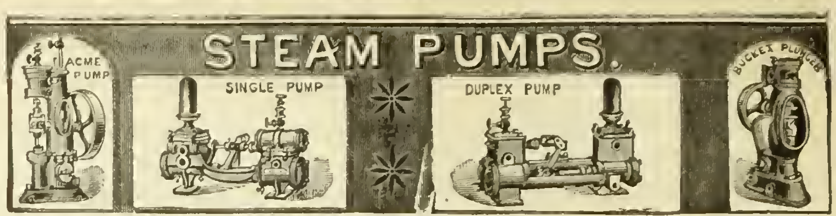

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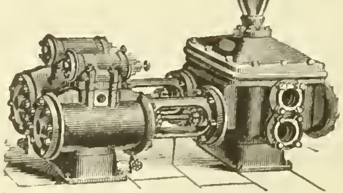

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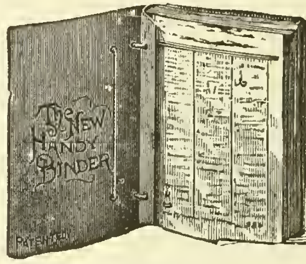

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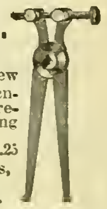

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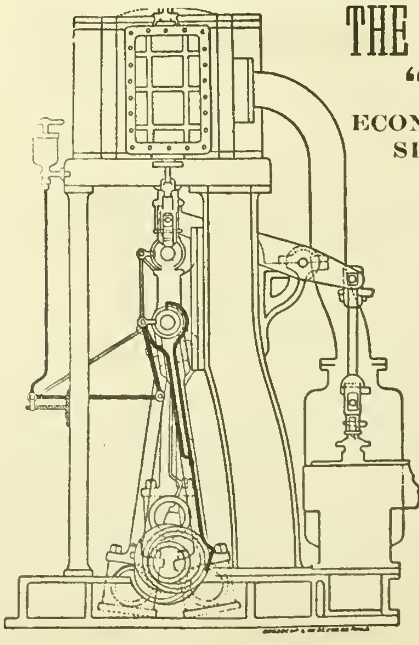

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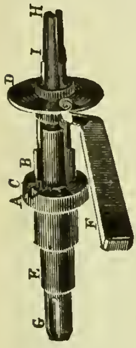

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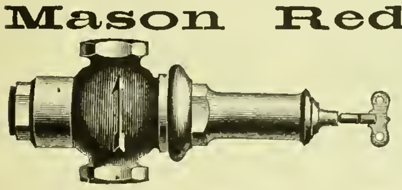

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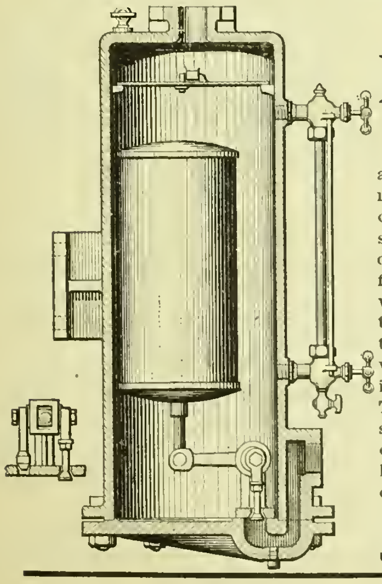

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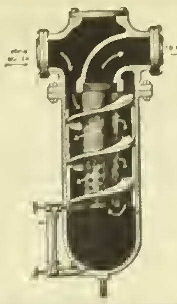

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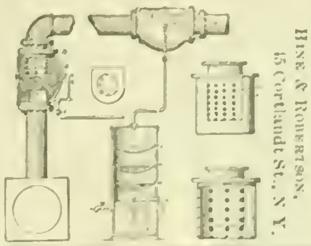

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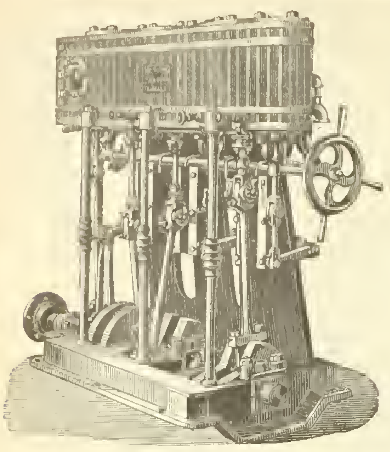

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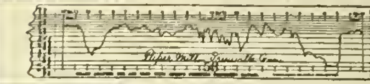

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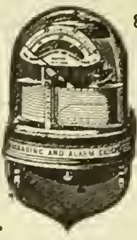

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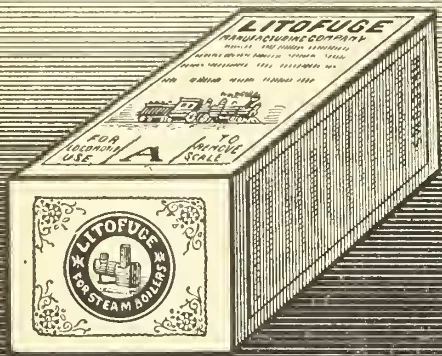

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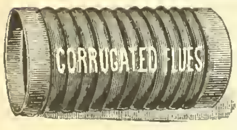

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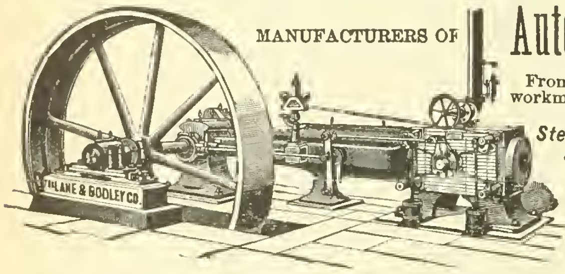
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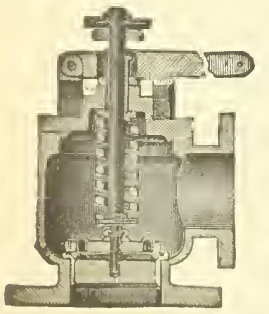

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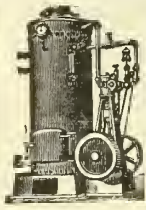

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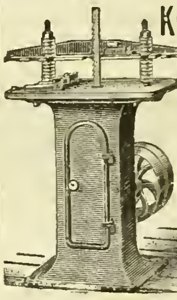

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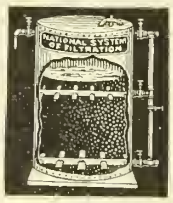

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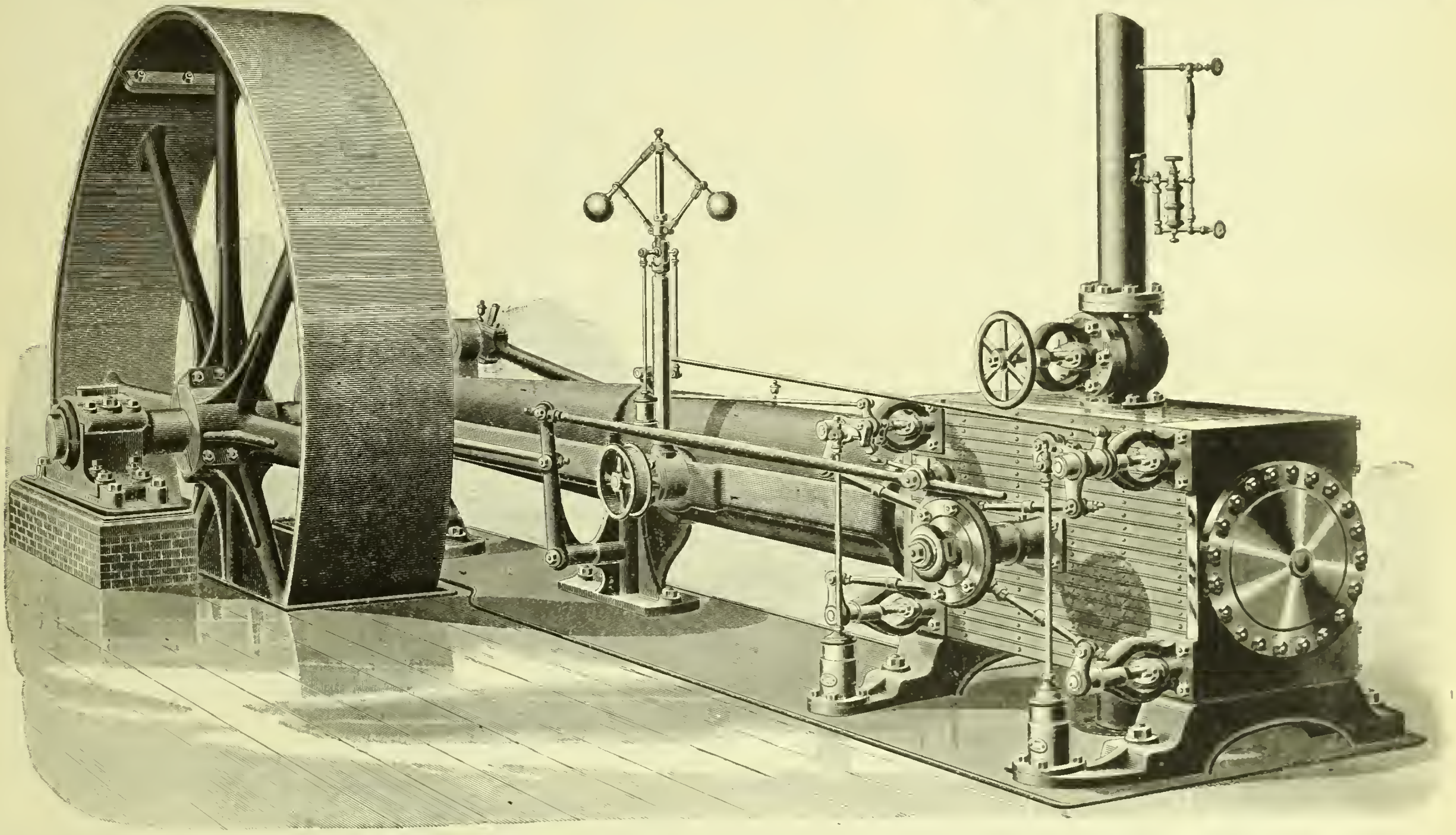
August 2. 1890.

THE FISHKILL CORLISS-ENGINE.

By THE FISHKILL LANDING MACHINE COMPANY, N. Y.

THE engraving represent a high-class Corliss engine which has many novel and excellent features in its design not to be found in others of a similar type. Aside from the workmanship and material employed, both of which cannot be surpassed, there are points in design which materially affect the action of the engine as regards steadiness of motion and absolute regularity of revolution; this last renders the Fishkill Corliss engine of great value in flour and cotton mills.

A disagreeable feature of most Corliss engines is the whistling of the dash pots, through the cushioning of the plunger in them upon the confined air. This being forcibly expelled through a small hole is more or less annoying, according to the sensitiveness of the spectator.



The valve gear is known as Cité's releasing valve gear, and while employing the Corliss valve and the general arrangement and details of the Corliss gear, has some points of novelty which we are unable, for want of space, to illustrate; suffice it to say that these features are such as to make the cut-off much sharper and quicker through the means employed to release the steam valve, and also to relieve the governor of any strain upon it, so that its action is positive and correct as to its control of the steam valve.

The dash pot used upon the Fishkill Corliss engine is also of the Cité patent, and is shown herewith. The illustration on next page shows this device. A is a cylindrical shell of different diameters, closed at the bottom by a bonnet A'. B B' is a plunger turned accurately to fit the shell. C is a rod attached to the valve-lever by means of a stub-end, and to the plunger by the ball-joint D. Under the plunger B is a chamber y, and above is an annular chamber x. The two are connected by ports ee', in which is a cock v, by which the communication between the chambers may be more or less obstructed. The operation is as follows: When the steam valve of engine is closed, the plunger is at the bottom of the shell. As soon as the valve begins to open, the plunger begins to rise, reducing the area of the chamber x, and increasing chamber y. As the plunger rises, the area of chamber y increases more rapidly than that of chamber x decreases, and as the air which was confined in chamber x now occupies a much greater space, a partial vacuum is formed in both chambers, which will increase as the plunger rises. When the cut-off occurs the atmospheric pressure, acting upon the plunger B, causes it to descend rapidly and close the steam valve. As the descent is rapid, the vacuum in chamber x becomes greater, and produces a retarding effect towards the end of the plunger's stroke, while the rarefied air under the plunger, being obstructed by cock r, acts as a cushion, which, in combination with the partial vacuum above, overcomes the momentum of the parts, and thereby prevents the pounding so frequently heard in other devices. As the forces which close the valve, and those which overcome the momentum of the parts, are proportioned to the lift of the plunger, the dash-pot adapts itself to any degree of cut-off; and, as there is no expulsion of air, the whistling noise is wholly prevented.

We are unable to do more than briefly advert to this excellent engine, and advise those interested to send to the company for their illustrated catalogue, which will supply fuller details.

◆

MR. W. H. FLEMING, in an article on "Ship Lighting by Electricity," in the *Electrical Engineer*, describes the change which has come over the lighting of ships during the last few years. The oil lamp in the olden days gave a ghastly hue to complexions, which, in many cases, were already materially impaired. One candle served two staterooms, being placed in a receptacle between them. At 11 o'clock a single smoky lamp was placed in the saloon as a night light, and no other illuminant was visible. The first transatlantic steamer to be lighted by electricity was the '*City of Berlin*' of the Inman Company, although its use was confined to the engine room and the main saloon. Now few steamers of any size, either passenger or freight boats, are without a complete electric light plant. A modern Atlantic liner lighted from stem to stern is a magnificent sight, and as the dynamos are kept running during the voyage all kinds of electrical applications are possible, ventilating fans for the staterooms and lower decks, motors for hoisting the ashes from the stokeholes, and many other purposes. It is not generally known that the total number of 16 candle-power lamps now in use on ocean steamers is not less than 100,000. This represents a consumption of 200 tons of coal per day, which would be equivalent on land to the fuel used in a central lighting station of the first magnitude.

NEW WHITE LEAD PROCESS.

THE evils attending the manufacture of white lead by the Dutch or stack process are well known. They may be summed up as expensiveness, nervousness, and danger to health. Attempts have been made to introduce other methods, but these, for the most part, have proved failures. A process for attaining the desired end inexpensively, quickly and safely, has just been brought under notice. This is the invention of Professor McIvor, F. I. C., and has been in operation for the past nine months in London.

In this process the litharge is first made from lead ore and thoroughly purified by washing. It is then put in a vat, and a solution of acetate of ammonia is run upon the litharge. The mixture is then agitated for six hours, so that the lead is fully absorbed into the solution, and it is allowed to settle. The superabundant liquor containing the lead is then pumped over into a second vat, in which it is submitted to the action of carbonic acid gas. By this means the lead is precipitated, and the acetate of ammonia recovered for use over again. If the litharge is very pure, the carbonic acid gas is introduced into the first vat, with the result that the white lead is produced direct, and the acetate of ammonia separated at the same time for re-use as before.

In either case, after the white lead has been precipitated, the mother liquor is drawn off, and the unwashed white lead is passed through filter presses to extract from it all the mother liquor. The pressed lead is then put in a washer, and agitated by stirrers in cold water. After eight of these washings the white lead is again passed through the filter presses and through a hydraulic press, from where it is removed to the drying room, and, when dry, is ready for use. The result is a pure white lead, free from crystals, and produced in a few hours, as against months by the ordinary method, the cost of production being also much less. The process and the products have been examined by several leading chemists, who include Profs. Crookes and Watson Smith and Dr. Dupre. All the operations in the manufacture of lead under this process are done in the wet, so that there is no dust, and no danger to health.

◆

A WRITER in the *London Engineer* says that English marine engines are now fitted with small tanks close up to the cylinders in communication with them, and the valve chambers through the usual drain cocks, while the amount of opening required by the smaller drain cocks on these tanks to maintain them nearly full (as they should always be), enables the engineer to estimate the relative deposition of water from each cylinder and receiver. It is interesting to watch the gauges on these tanks, with the engines taking steam from hard-fired boilers. When steam is admitted under the high-pressure piston the glass is filled with a mixture of steam and water in violent agitation, which instantly disappears when the exhaust port opens, and very little water is left behind, so that the drain on this tank varies from shut to the very smallest opening; while the tank on the low-pressure receiver fills in a very short time, unless the drain cock is kept well open.

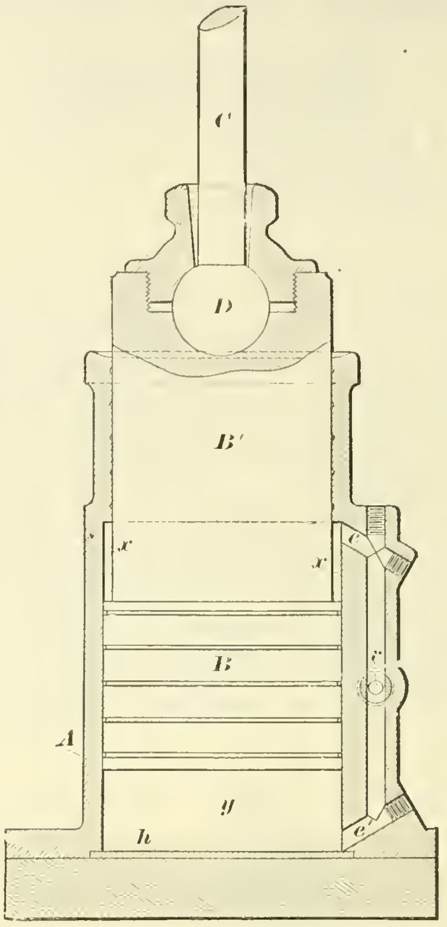
◆

THE number of people who have had rare and strange adventures, or who are accomplished and amusing liars, is considerable. They turn up everywhere. Everywhere they spin yarns of incidents in wild countries or of extraordinary affairs at home. In sport, war, business, amazing events are always occurring to these men. Some people have either the natural gift of attracting everything odd into their sphere or possess a fancy which is not restricted.

◆

A SOLUTION of collodion in alcohol effectually prevents silverware from tarnishing when not in use. It can be washed off by hot water.

THE necessity of having an invention well described, and every novel feature of the invention defined in both the drawings and specification, preparatory to filing in the Patent Office, was well set forth by the late Judge Grier, one of the distinguished patent law judges of the Supreme Court of the United States. He said: "There are few things more difficult, even for well educated and practical lawyers, than to describe a new invention clearly and point out the principle which distinguishes the subject of it from all things known before. As inventors are rarely experts, either in philology or law, it has long been established as a rule that their writings are to be scanned with a good degree of charity.

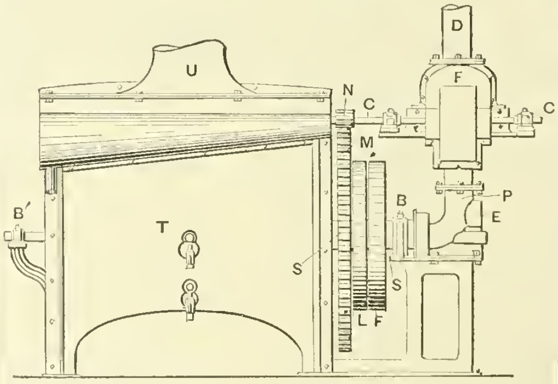


DASH POT, FISHKILL CORLISS-ENGINE.

◆

A "SMOKE ANNIHILATOR."

THE engraving shows a peculiar apparatus intended to do away with the smoke nuisance, as applied to an existing furnace and chimney. The idea, says *Industry*, is to wash the gases issuing from the chimney. The gases are drawn by a fan *F*, through the pipe *D*, and forced through the delivery pipe *P* into a hollow shaft *S*, forming a continuation of this pipe, and enclosed in the cast-iron tank *T*. From the interior of the shaft *S* the gases escape through holes of about 1¼ in. diameter, into the tank, which is partially filled with water. Paddles of perforated sheet iron are attached to the shaft inside the tank, and revolving at 150 revolutions per minute the water is thoroughly mixed with the furnace gases, which then escape by the uptake *U*. Through a pipe *E* to the delivery pipe *P*, the exhaust steam, or a portion of it, is allowed to mix with the gases and enter the tank. The shaft *S* is driven through the pulley *F* from line shafting. The wheel *M* drives by a belt *N* the fan shaft *C*. A water-gauge is attached to the front of the tank. The amount of power to drive the annihilator is said to be about 4 horse, but about how much it reduces the evaporation of the boiler through bad combustion, induced by suffocating the draught, nothing is said. It is not possible to use such an appliance with economy.



◆

WEBB'S HOME FOR SHIPBUILDERS.

WORKMEN have taken possession of a plot of thirteen acres of ground on Fordham Heights, New York City, and begun grading preparatory to digging the foundations for the new Webb Academy and Home for shipbuilders. The new home and school is being built by Mr. W. H. Webb, who made his fortune building ships. It will be the only institution of the kind in this country and the third in the world. The other two are in London and Paris. Mr. Webb got his idea from these institutions, both of which he visited before he settled upon the plan and scope of his own. He proposes to improve upon them in a number of ways. The object of the institution is to afford "gratuitous aid, support and relief to the aged, decrepit, invalid, indigent or unfortunate men who have been engaged in building hulls of ships or vessels, or marine engines for such, or any parts of either the hulls or engines in any section of the United States, together with the lawful wives of such persons, and also to provide and furnish to any young man, a native or citizen of the United States, who may, upon examination, prove himself competent, of good character, and worthy, free education in the art, science, and profession of shipbuilding and marine engine building, theoretical and practical, together with board, lodging and necessary implements and materials while obtaining such instruction."

Mr. Webb has obtained a charter for the institution, which names the following trustees: James M. Brown, Stevenson Taylor, Thomas S. Rowland, Charles S. Smith, Richard Poillon, W. P. Trowbridge, Henry Steers, Charles H. Cramp of Philadelphia, Albert J. Bogert and W. H. Webb. The work of building will be pushed rapidly.

◆

THIS is the argument of the Boston tide motor man: A motor calculated to produce 100 h.p. is a scow or float 150 feet long, 35 feet wide and 16 feet deep; this will give 5250 square feet of surface, and the weight of the float with the necessary machinery will amount to 1,500,000 pounds. Reckoning the displacement, it is found that the float level will be four feet; that is to say, with everything ready to work, the float will sink 4 feet in the water. It is then held until the tide rises sufficiently to make a displacement of water equal to the number of pounds pressure required to produce 100 horse-power. When this point is reached the machinery is set in motion and the power required is furnished. That is, only 7,000 tons carried on a draught of 4′ on a hull of the above dimensions! It will float on the bottom—like an anchor—with less than one-fourth the weight.

◆

A MAN recently put up a small fan driven by electricity to create a current in a store. It was about one foot diameter, and had many blades made of thin sheet brass. It ran several thousand revolutions per minute, and, of course, it simply howled like a fog-horn. The store keeper objected to the howling, but the man who put it up told him that was because it was new; after it got a little older it would not howl so much, but he could not convince the storekeeper that "age would wither, or custom stale" its infinite howling.

◆

ANOTHER discoverer of perpetual motion has been heard from. The world, too, has made a discovery, and that is that there is a perpetual succession of fools.—*Jackson Mississippian.*

AN experiment was made lately in Paris for the purpose of determining the character of foundations to be laid for massive structures on the Champs de Mars. The method pursued was to level a large surface of ground and place four rectangular blocks of cast-iron, 20 inches square, so disposed as to form corners of a square, the distance apart being eleven feet eight inches from center to center. The blocks were bridged by girders of T iron, and these were then loaded until a total weight of some 15,000 pounds was reached, when a settlement occurred, the pressure on the ground being 7311 tons per square foot; during the night the settlement increased three-fourths of an inch. The load was increased next day to 209,776 pounds, when some of the corner blocks had sunk out of sight, leaving the girders on the surface of the soil. The conclusion arrived at by these experiments was that the soil was capable of resisting a load equivalent to 5.43 tons per square foot; when the load reached 7.31 tons settlement took place, and the ground proved incapable of supporting a load of 8 14 tons per square foot.

◆

THE principal impurities found in water are carbonate of lime, sulphate of lime, and the carbonate, sulphate, chloride, and nitrate of magnesium. These impurities may amount to some hundreds of grains per gallon. In many cases the bulk of these salts has to be removed by some softening process, but this is expensive, and only the carbonate of lime can easily be removed. Sulphate of lime is a very constant impurity which cannot be removed by any of the softening processes, and when deposited in the boiler, forms a very hard non-porous scale which is easily burnt on to the plates In addition to these chief impurities there are many others, such as chloride of sodium in sea water, refuse chemical matter in certain rivers, acid water in pits and collieries, and alkaline waters containing soda salts. Most boilers are worked at a disadvantage as to consumption of fuel and durability, owing to the water being bad, and it is well-known that a very thin scale increases the coal bill and overheats the plates.

◆

THERE is a good time coming for engineers, and the remarkable progress lately made by their organizations points clearly to that time being not so far distant perhaps as most people imagine, when it will be possible for an engineer to assert his undoubted right to common fair play. This time will not, however, arrive unless it is hastened by united action and never-flagging exertion, and he must be a craven indeed who hangs back and allows his neighbor to do battle for him and his interests, or who keeps out of the way when he is wanted to take his share of the burden, and help to work out his own social salvation. Let such take heed to themselves now, before it is too late, for most assuredly they will have to pay the piper whether they dance to the music or not.—*Engineers' Gazette, London.*

◆

IT is stated that in painting wood, one coat takes twenty pounds of lead and four gallons of oil per 100 square yards; the second coat, forty pounds of lead and four gallons oil; and the third the same as the second, say 100 pounds of lead and sixteen gallons of oil per 100 square yards for three coats. The number of square yards covered by one gallon of priming color is found to be fifty; of white zinc, fifty; of white lead paint, forty-four; of lead color, fifty; of black paint, fifty; of stone color, forty-four; of yellow paint, forty-four; of blue color, forty-five; of green paint, forty-five.

◆

FLEXIBLE couplings are very justly recommended by many engineers, for the shafting will run perfectly well even when slightly out of line, as practically it is subjected to no bending strain, but it would take a pretty big coupling for engines of any power.

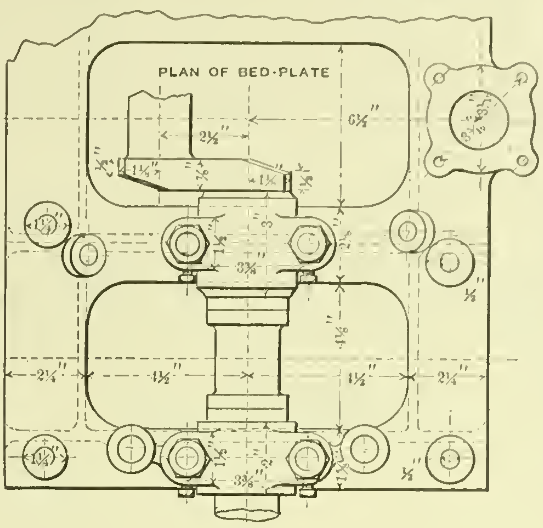
IN the Pennsylvania oil and gas regions it is customary to test pipe joints with air, and the joints are previously daubed with soap and water, which shows bubbles if there is the slightest leak. The contractor's trick there is to get some lime into the water.

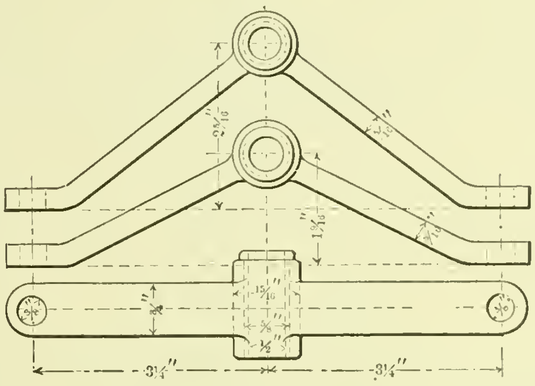
◆

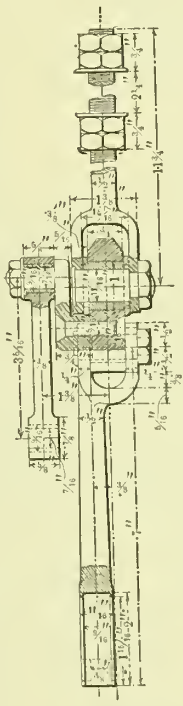
COMPOUND LAUNCH ENGINE. No. 3.

BY THE BUREAU OF STEAM ENGINEERING, U. S. N.

THE engravings in this issue represent the valve gear connections and bed plate, broken off, one end being a duplicate of the other as regards design, differing only in the cylinder dimensions.







◆

FRIEND WATSON, of THE ENGINEER, has come out with another definition of momentum. This time he says it is "the mass multiplied by the square of the velocity." This is worse than undertaking to express force in foot pounds, for if momentum varied as the square of the velocity you would certainly get enough momentum in a small mass to make the injector work. We always thought momentum was the product of mass and velocity. Penetrating power varies as the square of the velocity, but penetrating power and momentum are two different things. —*Boston Journal of Commerce.*

Our contemporary is right in its correction, and we thank it for its criticism. *Vis vira* (live force), which we had in mind as the effective power of a jet of water in motion, is $m \times v^2$, but momentum only is as the $m \times v$. We will let our contemporary settle the action of the injector to suit himself; he seems capable of deciding most anything on sight.

◆

IT would be well for some persons to remember that only a genius can write upon any subject without being acquainted with it and not write nonsense.—*Am. Machinist.*

Do you consider the daily paper reporter a genius? He can tell you all about a steam engine that he knows nothing about.

IT has been conjectured that the friction of the meteors which are incessantly rushing into the sun may produce light and heat in sufficient quantities to aid in the maintenance of the sun's ordinary expenditure. It has been even supposed that the quantity of energy thus generated may supply all that is wanted to explain the extraordinary circumstance that from age to age no visible decline has taken place in the intensity of the solar radiation. Here again is a question which we must submit to calculation. We have first of all to determine the heat which could be generated by a body of, let us say, a pound in weight, falling into the sun after having been attracted thither from an indefinitely great distance. The result is not a little startling; it shows us that such a body in the course of its friction through the sun's atmosphere might generate as much heat as could be produced by the combustion of many times its own weight of coal consumed under the most favorable conditions.—*Good Words.*

◆

SUPERHEATING the boiler steam to the degree of increasing its pressure before admitting it to the cylinders, has been tried several times in locomotive practice and as often abandoned. The chief difficulties met with were: The expense of providing and keeping up the superheating apparatus; the difficulty of lubrication, owing to the vaporization of the lubricants at the high temperature; the impossibility of preventing leakage at the stuffing boxes, all vegetable packings charring with the heat and becoming worthless. Nor is it likely that the metalic packings, now so largely used, would be able to overcome this last difficulty, for, with a possible exception or two, their prominent features are steel springs and white metal rings. The springs would gradually lose their temper and become useless, while the soft metal, fusible at temperatures of from 250 deg. to 400 deg. Fahr., would melt.

◆

IT was at one time considered that there was nothing to beat sperm oil as a lubricant, especially for the bearings of light machinery, but with the introduction of mineral oils the use of sperm has much fallen off. "Tested roughly by the indicator upon a whole mill full of machinery," says a careful investigator, "I once found that the power required to turn an equal weight of machinery was materially decreased by mixing the thinner mineral oil with sperm, which had hitherto been used alone. The point of least power was about half sperm and half mineral; more or less than this gave more friction."—*Marine Engineer.*

◆

A STATEMENT made by the *Engineering and Mining Journal* with much parade of detail, is to the effect that an electric motor which displaced a steam engine gave out 100 i. h.p. where the steam engine gave only 80 i.h.p. This is a valuable motor, when it can increase the power of steam 20 per cent. Since all electric power is derived from steam, a motor that can gain 20 per cent. on the original force ought to come into general use.

◆

MANY people rely upon the mechanic in some things in connection with his calling, while in other things rather than follow his advice they are led away by a pretty story. They rely upon him to build locomotives and printing presses, but when it comes to some scheme to get power out of one end of a machine without putting something into the other end, they believe the story told by a newspaper rather than be guided by long-known principles that can be learned in a mechanical paper.—*American Machinist.*

◆

THE '*Cushing*,' U. S. N. torpedo boat, is credited with 25.35 knots per hour, for 4 hrs. 44 mins. consecutively, but it was done by misrepresenting the distance she ran as 120 miles when it was but 90 miles.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

WATER HAMMER, ETC.

Editors ENGINEER:

Please answer the following questions through the columns of THE ENGINEER.

1. What causes the pounding noise in a steam pipe when I first turn steam on it? I think it is the steam striking on the cold water, but what I want to know is, why is it so powerful? Some time ago one of our tugs in this harbor burst her steam pipe from that cause with only 20 lbs. of steam, when she had been carrying 80 lbs.; it caused the death of her fireman. The pipe was copper and was pulled out of the flange.

2. In an argument with an engineer he said there was very little if any friction on a slide valve, and that its own weight would bring it down on the down stroke if it was well oiled and stem properly packed. I insisted that there was considerable friction on both strokes, and to prove it I removed the bottom strap from the eccentric while the engine was running, and to my surprise it made no difference, the top strap never left the eccentric one bit. Please say what per cent. of friction is allowed for a common slide valve if there is any; I can't see why there is not a great friction.

3. The engine I am running is a compound one, 15″×26″ by 22″ stroke, common slide valve, cuts off steam at half stroke on both cylinders, steam pressure 75 lbs. How much pressure ought I get in the receiver of the l.p. cylinder?

4. Does water expand by heat?

5. I left a monkey wrench in my boiler some time ago and it stayed there for one month; when I took it out it was eaten so badly it was no good; all the threads were eaten off the screw and all the iron part of it was pitted to a depth of $\frac{1}{8}''$; the boiler shows no signs of pitting. What caused this?

A. C. EVANS,
Norfolk, Va. M. E. B. A. No. 60.

[1. Water hammer. When steam is turned into a cold steam pipe it condenses and forms a vacuum, and if there is any condensed water in the pipe the same flies into the vacuum with great velocity, like a solid ram. Stop valves have been knocked to pieces by water hammer frequently; it is easy to prevent it by opening the throttle slowly, though most throttles leak so much that they keep the steam pipe hot all the time. 2. The slide valve of the h.p. cylinder on a compound engine runs very light by reason of the back pressure in the cylinder; you do not say which cylinder it was that you tried the experiment with. We doubt if the l.p. cylinder valve would act in the way you describe. In Giddings' experiments with the friction of slide valves, he used a carefully constructed dynamometer for the purpose, and the results obtained were that from 1½ to 2 per cent. of the power of the engine was required to drive them. The friction is much less when the engine is running than when started, by reason of the back pressure. 3. About 15 pounds. 4. Water expands one twenty-second part of its volume between 39° and 212°, but water under pressure in a boiler rises mechanically, or is lifted by the steam forcing its way out. Three gauges of boiling water, or water at 212°, will not be three gauges at 60°. 5. We are unable to account for the monkey wrench.]

TOO YOUNG YET.

Editors ENGINEER:

I would like to know what steps I should take to become a thorough engineer on a locomotive, which is my intention. I have taken at times different mechanical papers (yours included), which I am interested in very much. Some one told me that I'd have to get a job on a locomotive or a steamboat as an oiler to begin with. Is this what I should do or not? If it is possible I should like to get on a locomotive of a local train. I am 5 ft. 5¾ in. height, healthy and strong, and fourteen going on fifteen years old, and know how to take care of myself. If I could be an oiler on a locomotive I think I would be of some help in different ways.

I've been trying hard to find some one or some paper that would answer my question, but did not succeed, so I ask you kindly to accommodate me with an enlightened answer, which will oblige me very much.

H. E. R.
N. Y.

[Our correspondent will have to tarry a while until he gets a little older. A boy of fourteen is too young to fire on a locomotive. If he makes himself useful in a round house he can make interest while he is growing up, and then get a chance to fire. At present he would meet with refusal.]

WANTS A GREASER'S BERTH.

Editors ENGINEER:

Will you kindly advise me, a young engineer of six years' experience with land engines. My ambition is to become a marine engineer; now, how can I get there? Will I be able to get on as second or third engineer, or even fourth as a commencement, and do the rest? What pay do they get? Now, Mr. Editors, I ask for good solid advice. Long live THE ENGINEER.

HARRY MANSFIELD.
Cornwall, N. Y.

[Apply to the superintending engineer of any steamboat line, and state what you want. You will have to go as greaser first, as no marine engineer can be licensed who has not had one year's experience in an engine-room. The pay of a greaser is about $40 per month and found; less in some cases.]

FROM CHIEF ENGINEER GEORGE H. FERGUSON, Ss. 'CHINA,' P. M. S. CO.

Editors ENGINEER:

I have neglected to write before, as I have been so busy, that, as a matter of fact, I have had no time to do anything but look after this ship. You readily understand that a new fast ship, with all the modern improvements, requires *all* ones' attention. At the same time I feel as though I have neglected you in not having before written you of the *record breaker*; no doubt you know all about her.

We left Glasgow for Cardiff, loaded coal for Hong Kong, and were 27 days from departure to arrival, three days of which were in the Suez Canal from Port Said to Suez; that is the best time on record, and then we were not turning at all; then we were 3 days 20 hours from Hong Kong to Yokohama, distance 1,600 miles, beating the best time by many hours. Then 12 days 20 hours 54 mins. from Yokohama to San Francisco. This is not doing as well as we can do, for we can run it in 11 days, such weather as we had this voyage. Now we are running on schedule time, but this time were 13 days — hours — mins., using half the boilers.

The '*China*' resembles the '*Alaska*' very much, and was built by the same firm, Fairfield Ship and Engine Building Co. She is 462 ft. × 48′ beam; cylinders 40″ × 66″ × 106″ 6 × ft. stroke; 160 lbs. steam, supplied by six double ended steel boilers, and can make 17½ knots at sea in fine weather right straight along; we have averaged 19 knots for 386 miles, with a ¼ knot current in our favor. She is a fine ship, and the engines and boilers are a splendid job, but I am sorry to say the '*China*' is *not* an American vessel. I read with pleasure Joe Dennett's letter in THE ENGINEER for March 17.

GEO. H. FERGUSON,
Chief Engineer Pacific Mail Ss. Co.s Ss. '*China*,'
San Francisco.

[We are glad to hear from Bro. Ferguson and his success with his new charge. Many "old timers" will learn his address from this letter and can reach him.—EDS.]

SURFACE CONDENSERS.

Editors ENGINEER:

I am a constant reader of THE ENGINEER for the last three years, and saw in the July 5 number an item on keel condensers. Would you please state through your paper what cooling surface it takes for a surface condenser to the horse-power.

GEORGE SMITH.
Galveston, Tex.

[Ocean steamers have from 1½ to 2 square feet per h.p.]

IN MEMORIAM.

At a regular meeting of M. E. B. A. No. 50, held at their rooms, 287 Hudson Street, New York, July 15, 1890, the following preamble and resolutions were adopted:

Whereas, In view of the loss we have sustained by the decease of our friend and brother, John Fagin, and of the still heavier loss sustained by those who were nearest and dearest to him; therefore be it

Resolved, That it is but a just tribute to the memory of the departed to say that in regretting his removal from this world we mourn for one who was in every way worthy of our respect and regard.

Resolved, That we sincerely condole with the family of the deceased in the dispensation with which it has pleased Divine Providence to afflict them, and commend them for consolation to Him who orders all things for the best, and whose chastisements are meant in mercy.

Resolved, That this testimonial of our sympathy and sorrow be inscribed in our minutes, and a copy forwarded to the family of our deceased brother.

Resolved, That in honor of our departed associate we drape our charter and altar for a period of thirty days.

ANDREW M. LESTER, *Pres.*,
G. MARION WHITE,
JAS. H. SIPPERLY,
WM. S. HOULTON,
Committee.

◆

ABOUT two thousand tons of grindstones are used in the manufacture of files yearly, while from 4,000 to 5,000 tons of steel are annually cut up and made into files. The larger concerns of this country manufacture, or have the capacity to manufacture, from 800 to 1,500 dozen a day, and over 90 per cent. of the files now used are cut and almost entirely made by machinery. To a very small extent, for making a few special files, or re-cutting old files, the work is still done by hand, but this method of manufacture is fast becoming a thing of the past.

NAPHTHA LAUNCHES.

NAPHTHA launches appear to be established facts so far as the purposes for which they have been designed are concerned. Few inventions have met with deeper prejudice and with quicker acceptance at the same time. At first everybody was afraid that they would explode, for naphtha has been on record as a terrible destroyer in cases of misapplication or improper treatment. The method, however, by which it is made to serve as a fuel precludes any possibility of explosion. Nearly six hundred naphtha launches are now in use, and manufacturers are crowded with orders months in advance.

The inventor of the naphtha motor is August W. Ofeldt, Brooklyn. He has a shop at the foot of the street, where he makes launches in which naphtha serves as fuel to generate steam. The launches made under his invention, wherein naphtha is the exclusive motive material, are not now in his control, for he sold his inventor's interest in the patent to the Gas Engine and Power Company, of Morris Dock, this city. Mr. Ofeldt was born in Sweden about fifty years ago, and he gained his scientific and mechanical education there. He came to this country twenty years ago. It was while he was working with gasoline that the idea of utilizing naphtha as a motive agent occurred to him. That was ten years ago, and for five years he studied and experimented before he constructed an engine that satisfied him. That engine is still in use in New York waters, and generally appears at events where naphtha launches are likely to be. It is in a small boat that looks as if it might have been a rowboat, and its name, painted in conspicuous white letters, is '*The Original No. 1.*' When J. A. Bostwick, Clement Gould, John J. Amory, Edward V. Cary, and others with capital, took up the invention, they began making boats specially designed for the naphtha engine, and eventually they acquired Mr. Ofeldt's interest. The inventor says that there is still room for improvement in the engine, and that he proposes some day to bring out one that will open a new era in pleasure navigation, and possibly lead the way to the use of naphtha in larger marine enterprises.

At present naphtha launches are used almost exclusively as yachts, though there are ferries here and there over which passengers are carried on them, and some of the larger steam yachts have abandoned steam launches for naphtha boats as tenders. People who are not familiar with them are often astonished to see a trim little boat, with a bright brass funnel in the extreme stern, scooting speedily about, emitting a rapid, sputtering cough, but showing no sign whatever of smoke or cinders.

It takes five minutes to get up "steam," to use another misnomer, on a naphtha launch. Then all that is necessary is to work the pump a stroke or two, apply a match to an opening in the surface of the funnel, turn a cock, and let her go. From that time the launch will go continuously for fifty hours. Then the supply will be exhausted, and the forward tank will have to be replenished. The engine may be stopped at any instant by shutting of the supply of naphtha, which is equivalent to turning out a gas jet, and the engineer may go home at once with no cleaning up to do and no fires to rake down.

These launches are from 18 to 53 feet long. The draught varies from 18 to 38 inches. Six to ten persons may be carried safely in the smallest boats. The most popular style of launch is the 25 footer, in which there is room for twenty passengers It costs fifteen cents an hour for the power necessary to run a boat of this size.

The speed of ordinary naphtha launches is about seven miles an hour with a four horse engine. Some launches with six horse engines have made a recorded speed of ten miles an hour.—*N. Y. Sun.*

◆

AN excuse is a confession of fault.

ONYX.

ONYX is coming into general use for decorative purposes; its use has extended until it is becoming one of the most fashionable decorations in New York. Onyx is a peculiar formation caused by drippings mixed with mineral and earthy substances under heat and pressure. This is not an exact geological definition of it, but it tells what it is. Onyx is usually discoved in caves and other natural openings in a mineral neighborhood. The most beautiful kind is formed by various kinds of minerals running through it in treaks and tints.

It differs from marble in taking on a higher polish, in being harder, with a greater reflection, and a close, firmer grain.

Onyx is got out in as large blocks as it can be quarried. The quarrying has to be done with wedges and saws, as it cannot be blasted or dug out with safety. The grain is so delicate that a blast might spoil thousands of dollars' worth. Onyx is worth in the rough from $3 to $15 per cubic foot. The price is not steady, as it depends on the demand and the length and shape of the block as well as appearance. A man who buys a block of onyx takes it to some extent on speculation. He does not know how it will saw and polish. There may be cracks inside of it which he does not see, and the grain and streaks on the outside may not be carried through.

Onyx in its rough state looks like other stalactites and stalagmites, though it might be taken for marble by any one not in the business. It is worked much as marble is, by sawing and polishing, except that more care has to be exercised and that the polishing is more difficult. When it is worked up it will sell for $1 to $5 a square foot, according to its appearance and size.—*N. Y. Sun.*

THE NEW GAS GUN.

M. PAUL GIFFARD'S reputation as inventor of the pneumatic tube and the "Giffard Injector" stands so high that any invention of his is worthy of attentive consideration.

The weapon now introduced by him is a discovery which not only promises to revolutionize the gunmaker's art, but is applicable also to purposes as a motive power. The idea of using liquefied carbonic acid gas as a propulsive power is not new, but M. Giffard is the first who has turned it to practical account.

The gas gun is a model of simplicity. A small cylinder is attached to the barrel. This cylinder contains liquefied gas enough to discharge 220 shots, equal to about 50 bullets of an ordinary service rifle, with a velocity sufficient to kill at 600 yards. The charge of liquid liberated for each round is regulated by a screw, and each charge is contained in a special chamber, from which it is released by the pulling a trigger. The bullet is dropped separately into an orifice in the breech lock. In the rifles shown the bullets were round, but elongated bullets can be used. When the guns were discharged, vapor was seen issuing from the muzzles, but it instantly faded, and the bullets flew with precision to the targets. Barrels which had been repeatedly discharged in the past two months were shown to have suffered no corrosion. The pressure of the gas and fluid in the magazines was 500 pounds on the square inch, and this pressure is maintained up to the last drop of fluid.

The inventor says there would be no difficulty in refilling the cylinders with gas on the battlefield; but it is obvious, even if that be the case, that reserve cylinders would have to be supplied to each man in order to make up the number of rounds now thought to be necessary, and, as bullets would of necessity be carried in addition, the ammunition for a gas gun would weigh just as much as ordinary cartridges, weight for weight.

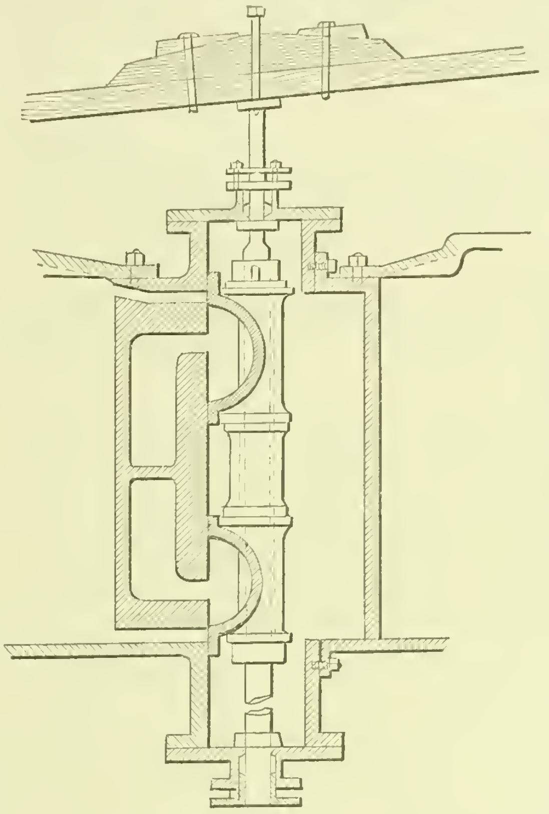
◆

THE attention of Uncle Sam is requested to the postmaster at Warwick, Kan. This worthy sends us a stop notice endorsed, "*Parties WhereBouts Unknoun.*"

WHEN the Saturday half-holiday law was enacted some predicted that its operation would not only injure business, but lead to an increase in crime because of the idleness of thousands of working people. Strange to say, the police records show a decreased percentage of arrests since the law went into effect. It was the purpose of the law to afford wage earners an opportunity to enjoy a half day's recreation during the summer. Two years' experience has proved that the men for whose benefit the law was passed have spent their time in peaceable excursions and pastimes. The parks in this city and in Brooklyn have been crowded on Saturday afternoons as they never were before, and the carrying capacity of excursion boats tested to the utmost. All this goes to show that the American citizen is fully able to enjoy a holiday when it is forced upon him by the law.

A BROKEN VALVE STEM.

A CORRESPONDENT of the *Engineers' Gazette*, London, describes the plan he devised to run his engine with a broken main valve stem. The engraving shows it so clearly that no explanation is needed. He got a plank, laid it over the stem, made one end fast, and piled a lot of grate bars on the plank. The eccentric of course worked the valve one way, and the weights worked it the other way. He made seven knots an hour, and ran 150 miles with this rig. Good man.



◆

AT the Westinghouse Electric Company there is being constructed an apparatus, which, it is expected, will overcome the present objectionable features of the street car motor. Instead of driving the car with gear wheels, hydraulic transmission will be used. The motor will drive a pump which will pump oil into a suitable cylinder on the car axle, and thus cause the car axle to revolve without the intervention of gearing. With this device the electric motor is run constantly at an approximately uniform speed, and provision is made so that the quantity of oil pumped by it varies from nothing to the full capacity without varying the speed of the motor, having the effect of exerting an immense pressure for starting the car and moving it slowly, and of delivering a large quantity for the purpose of moving the car at speed.

◆

A BADLY balanced pulley, running at a high speed, will impart an unsteady motion to the belt running on it. The machine so driven makes bad work.

◆

THE population of New York city is declared by the census to be 1,513,501.

A YEAR ago the Virginia and Gold Hill Water Company's employees repaired a disjointed pipe, and put in a "sleeve" to permit of its expansion. Three days ago they were called upon to lengthen the "sleeve," and readily calculated that the "sleeve" had moved ten inches in one year. In some parts of the town the ground compresses, and in other parts it stretches. To accommodate this action of the lode the water company puts in "sleeves" in its fire and water mains. The pipe columns that lead water to the electric motors on the 1,600 level of the Chollar mine are also provided with "sleeves." During the process of putting in those pipes the heat expands them to a considerable extent, and when the cold water is turned into them their shrinkage can be observed with the naked eye. It makes a difference of about eight inches in 1,700 feet, leaving so much space between the foot of the pipe and its base. If it were not accommodated with a "sleeve," the action of the water in the pipe would tear everything to pieces. The Water Company's tanks on the side of Mount Davidson are all situated in the "country" formation—off of the lode. They don't move. Pipes lead from the tanks to the moving lode. The pipe comes to the bank separating the two formations, and at that point a double elbow is put in the pipe, and as the lode lowers away from the immovable country rock, the double elbow accommodates itself to the movement.

◆

IT is not often that an invention for use in manufactures should become an active cure of disease. Aniline was discovered by Unverdorben in 1826, while experimenting with indigo; it is separated into a poisonous, colorless oil, with a slight aromatic smell. After a prolonged use as a dye-stuff these derivatives of indigo have entered the materia medica. Stilling and Wortmann began by experiments on rabbits and guinea pigs, which proved that in small doses, without the use of arsenic, preparations of aniline, itself an active poison, were harmless. They then proceeded to use the aniline solution on eye diseases and ulcers in guinea pigs. Successful there, they have operated on human beings, and made wonderful cures with ulcers, sore eyes, wounds badly inflamed, and other surgical cases. It is now proposed to treat parts of the body which cannot be reached by lotions or the knife, like the organs and parts affected in pleuritis and peritonitis.

◆

PEOPLE who are still inventing the duck's foot propeller may be interested to know that John Fitch tried it in 1785, but long before him two Frenchmen, Jouffroy and Papin, had also invented it and given it up as no good. The stern wheel was first applied by Symington in Scotland in 1801, and Pat Miller, another Scotchman, invented the twin-hull vessel about the same time, with paddles working through the bottom of each hull. People who are constantly re inventing all these things might save money by reading up a little.

◆

A MAN who guesses at things says this:

> "If the slack side of a main driving belt runs in wave form, it is certain that the engine is getting more steam on one side of the piston than on the other."

Well, then, gas and air engines must make bad work, for they get the impulse on only one side of their pistons, the flywheel doing the rest. We guess the belt jumps because one or the other of the pulleys runs out of truth.

◆

As a specimen of what modern marine engines are capable of enduring, the record of the White Star steamship '*Doric*' is worthy of note. She has just returned from a trip around the world, and she steamed continuously without slowing or stopping for 77 days, 6 hours and 50 minutes, making 28,000 miles. This is only one week short of three calendar months, and is an extraordinary performance.

THE ENGINEER.

FORTNIGHTLY. - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK, AUG. 2, 1890. No. 3.

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Owing to the recent decease of the junior member of our firm, an opportunity is offered to an enterprising man to acquire an interest in THE ENGINEER, and to so identify himself with it that the property will become his upon the demise of Egbert P. Watson. The means by which this can be accomplished will be shown at a personal interview. No assistance is needed in the office, and no shares are for sale. No money is required to be paid down, and the sole ownership of THE ENGINEER will remain for the lifetime of its present holder. The property is without any incumbrances of any sort, kind or description, and has no debts, as it pays cash for all supplies. It has a paying connection, which can be largely increased by a man of energy.

It is respectfully requested that no one will apply from motives of curiosity or without an earnest purpose in view.

EGBERT P. WATSON.

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LICENSES FOR STATIONARY ENGINEERS.

We observe that in England and Scotland an attempt is being made to license engineers of stationary engines, in order that a better class of men may be obtained and the public service improved. The *Mechanical World* says of it:

> As an example of a successful attempt to provide on a small scale what Mr. Fenwick's bill aims at doing for the nation, we may cite the case of the *Glasgow and West of Scotland Engine Keepers' Association.* Acting in the technical interests of the members, the association recognizes neither trades unions nor any society of a similar nature. The examining committee, selected from leading land engineers, manufacturing and professional, scrutinizes the written answers to the questions set, and award certificates to candidates possessing the requisite knowledge and practical experience. It is in this question of examination that, in the event of the bill becoming law, the greatest difficulty may be anticipated. If, for example, a theoretical knowledge of the laws of combustion is included in the Board of Trade requirements, many a careful fireman might fail to obtain a certificate, although from practical considerations he may be justly entitled to it. Government examinations nowadays have an unfortunate tendency in this direction. In several towns in Germany—Munich, for example—the boiler insurance companies offer facilities enabling firemen to become well grounded in the efficient firing of steam boilers, a station being provided where several varieties of boilers are installed for the purposes of training stokers and testing various kinds of fuel. It is evident that an attendant who has thus undergone a few weeks' training and who is armed with a certificate to that effect, is in a much better position to obtain employment than the unskilled laborer. If facilities such as these were offered to the rising generation there would be less need of such a bill as that now under consideration, since employers would speedily realize the fact that the employment of certificated engine and boiler attendants was in a measure equivalent to insuring their plant against accident.

This is a very natural deduction to make—that employers would seek out the best engineers they could hire for their plants. But in this country it is quite the reverse as a rule, and there is but little incentive for men to educate themselves with the expectation that they will be sought for upon showing their ability. Here and there there are exceptions to the rule, but the great majority of steam users in this country grade men by the price they can get them for—the cheapest man is the best. There are any quantity of steam plants in this country in charge of men who are mere laborers, and do not get even the pay of a good laborer. There are manufacturers in the large cities of this country who hire engineers for $8.50 to $10 per week. In New Bedford, Mass., an engineer of a large shoe factory there told us some six years ago that the average wages paid to engineers in that city was not over $10 per week, and some of them got only $8.50. New Bedford is not the only place where engineers work for less than the pay of day laborers, for in Elizabeth, N. J, their condition is nearly as bad. This seems to be a case where compulsory legislation would be beneficial if anywhere. We are compelled in certain states to send our children to school; the community says it will not have them growing up in ignorance to become a tax upon the more intelligent portion of the public. If compulsory education is in order, why are not compulsory measures affecting the safety of life and property equally desirable? We think they are, and that steam users of plants up to fifty h.p. should be compelled to pay such prices as would ensure capable men. If this was done there would speedily be a change in the character of the steam service. License laws do not reach the case, for they are easily gotten around or ignored flatly.

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Crushed steel is said to be coming into use for cutting metal. It appears to be made by quenching very high carbon steel in cold water from an excessively high temperature, such as would overheat steel for most purposes. This renders it not only hard, but rather brittle, so that it is possible to pulverize it; it is crushed in a stamp-mill, and sifted closely to size. It is said to be not only cheaper but much more effective than emery, giving a better polish and quicker, and lasting much longer.

FACTS IN REGARD TO ELECTRICITY.

The remarkably florid statements which are made respecting the future of electricity and the part it plays in the industries of the world, seem to be unnecessary; there is no question as to the utility of electricity and its adoption for many purposes whereever there are facilities for its manufacture cheaply, but the penny-a-liners who write it up constantly lose sight of the fact that it is a secondary power and must be made by some other power primarily. The further fact that up to the present time no means of storing it away have been found that are practicable, will limit its usefulness and its field of action, until some reservoir is discovered which is better than the one now known. The objection to this is its great weight. Launches and railway cars have been and are driven by electricity; for launches the storage battery is indispensable, but its enormous weight and the time required to get up electricity enough to run the boat continuously, make it simply impossible for practical purposes. If a storage battery in a launch is to be run ten hours, it takes ten hours to charge the battery, and it weighs far more than an engine and boiler. This, and the cost of electricity, makes it unavailable for pleasure boats. For motors in shops, or industrial purposes, electricity has its uses, and it is here that its chief value lies, aside from illuminating work, but electricity is much too expensive for industrial purposes, where steam can by any possibility be had. The charge for electric power in this city is $12.50 per month for one horse-power, or $150 per year, but steam power of the same value can be had for $90 to $100 per year. This will always be the case where electricity is manufactured by steam, for, in changing steam power into electrical power, a loss is incurred in no case less than ten per cent. and in many cases far more, according to the efficiency of the dynamo. This loss has to be paid for by the consumer, and it is for him to consider whether it is for his interest to pay fifty and sixty per cent. more than he would for steam.

More loose statements are made as to the value of electricity and its cost to manufacturer, by those interested in it, than upon any other similar topic we are acquainted with. In order to make it available, and to supplant steam on railways, the advocates of electricity say that it costs "about" 15 pounds of coal per horse-power per hour to run a locomotive. The facts are that locomotives cost no more to run than Corliss engines, so far as the consumption of coal is concerned. The locomotives on the elevated railway of this city have been tested by a competent engineer, and he asserts that (from the one that was tested) they run for 3 pounds of coal per horse-power. Considering the work done in stopping and starting so often this is remarkable. Prof. Jacobus, of Stevens Institute, tested a locomotive in passenger service on the Central Railway of New Jersey and found the same economy; there are not many Corliss engines, certainly no slide valve engines which do better, day in day out.

It does not seem necessary to pervert the facts in order to make a place for electricity.

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"IRON AND IRON."

There is no doubt but that many machines have disappointed the designers of them through too much detail, and by having too many loose parts which are intended to take up wear. Now, inasmuch as these last are more or less insecure, they allow a certain amount of vibration or spring, which is fatal to satisfactory performance. It is difficult to specify in an article of this kind exactly what we allude to; perhaps it is not necessary to do more than mention the fact itself. Most engineers who have ever overhauled an old-fashioned stationary engine with quarter brasses, so-called, which were adjusted by set screws through the pillow block bearing on the back of the brass, will know what we mean. The shaft found out the hard spot behind the brass—the end of the set screw and bore upon it the most, with the result of often breaking the brass, or at the least heating it. Provision for wear is in most cases entirely superfluous, for the wear is so slow that in a term of years it would be hardly perceptible, not so much in fact as is entailed by the adjustable detail; with this there is constant temptation for the tinker to go at it with his screw wrench, inducing wear by setting up parts that did not need attention.

What we have said applies particularly to all high speed machinery, whether engines, blowers, centrifugal dryers, or what not. With these there is no security greater than that afforded by iron and iron details, and no work is first-class that is not so made. The wear is much less where machines have solid surfaces to work against, to say nothing of the performance in daily work.

PRIZE ESSAY, AMERICAN PUBLIC HEALTH ASSOCIATION.

We must not question the sincerity of the motives of those who are endeavoring to benefit their fellows, although we may not see the usefulness of their aims. But it has always been difficult for us to understand what the advocates of certain diets or mode of living for workingmen expect to achieve. Their argument is that great waste of food goes on, and that the food itself is not suited to the needs of workpeople; therefore, those who are acquainted with the values of certain foods, considered from the point of their bone and muscle making properties, have made a schedule of them and published them in book form, with directions how to prepare the food. In short, it is a cook book, no more or less, with the exception that it specifies the quantities, proteids, fats, carboyhdrates, etc., in the food.

We respectfully assert that this method of improving the race and making it healthy, wealthy, and wise, is likely to fail from want of popularity. We do not think that there are any people on the globe who care a snap for proteids or carbohydrates in their food, but eat what they can get regardless of the chemical constituents of it, simply for the reason that they prefer it. This is acknowledged by the philanthropists, and it is to remove this mistaken course that they have published their work; because, say they, the work people can live so much cheaper if they will only follow our plan. This is not proven, and is not susceptible of proof for want of data.

The work to which we have alluded is the "*Prize Essay of the American Public Health Association,*" and can be had for forty cents by addressing Essay Department, American Public Health Association, drawer 289, Rochester, N. Y.

CUT THE STRAP.

A correspondent writes asking whether an engineer in straits is justified in destroying work in order to save delaying a train. He mentions, as a case in point, a broken side rod on a locomotive. Often, he says, the bolts become offset in the rod and strap so that it is impossible to drive them out in the usual way, but they could be gotten out in a few moments by cutting the strap in two across the bolt-holes with a flogging chisel; men dislike to do this, because they do not want to be blamed by the master mechanic for destroying work.

As to the course to be adopted in any given case it must depend upon circumstances. When trains break down, not only that train, but all others behind are delayed. The cost of delaying trains cannot be estimated; it may amount to thousands of dollars; in any event it costs the company considerable. Now the value of a strap on a side rod is $8 or $10, more or less, and if cutting it will free the train, the company will make money by doing so. We should cut the strap, but before doing so, we would be sure that nothing else could have been done.

LATEST LEGAL DECISIONS ON TRADE.

Reported for The Engineer.

[We shall until further notice publish the latest decisions in courts of last resort upon topics of general interest to our readers. From these decisions they will be able to judge in a measure of their own chances in similar cases.]

Power of Insurance Agent to Bind His Company.—The agents of an insurance company, authorized to procure applications for insurance and to forward them to the company for acceptance, are the agents of the insurers and not of the insured, in all that they do in preparing applications, and if the insured was not aware of the contents of the application he would not be bound by it anyway.—*State Ins. Co. of Des Moines,* v. *Jordan, Supreme Court of Nebraska, 45 N. W. Rep.* 792.

Payment of Premium on Insurance Policy.—An insurance policy was about to expire, and the company sent to the assured a blank application for renewal requesting him to sign and return, and telling him that what dividends belonged to him should be credited on the new policy. The policy was forwarded, purporting on its face that the policy was paid, and no demand was made for the premium. The fact was *prima facie* evidence that the premium had been paid, or payment waived.—*Whiting* v. *Mississippi Valley Mut. Ins. Co., Supreme Court of Wisconsin, 45 N. W. Rep.* 672.

Misrepresentations in Application for Life Insurance.—A life insurance policy made the statement of the application a part of the policy, and also made any misrepresentations in such applications a ground for avoiding the policy. An applicant gave as his family physician one who was not, nor had been within the year acting in such capacity. This was sufficient to avoid the policy. —*Phillips* v. *New York Life Ins. Co., Supreme Court of New York, 9 N. Y. Sup.* 836.

Discharge of Cargo—Demurrage.—A vessel having four hatches from which she could discharge her cargo, was by the terms of the charter-party to be discharged as fast as she could deliver. She delivered a part from one hatch into lighters without asking for a lighter for another hatch, but afterward when moored to a wharf she asked to deliver from the other hatches, but was refused. Demurrage may be recovered for the time she lay at the wharf, but not for the time she was unloading into lighters.—*The Glenfinlas, District Court of the United States, Southern District of New York, 42 Fed. Rep.* 232.

Lien on Vessel for Wages.—The fact that the master of a vessel brought suit for his engineer's wages, claiming a less sum that he knew was due him and the engineer only ratified the bringing the suit and not the amount, will not preclude the engineer recovering the balance due him when the ship arrives in a port where he can get a lien. The sale of the vessel will not defeat his lien when the purchasers were part of the old company and could have known of his claim.—*The Lillie, Circuit Court of the United States, Southern District of Florida, 42 Fed. Rep.* 237.

Servant Injured by Willful Neglect.—The Kentucky statute gives the heirs of a man whose life is lost through willful neglect of a corporation a cause of action against such corporation. When a man was killed by the rotten condition of a trestle, which appeared sound and would have required cutting into to discover that it was rotten, the company was not guilty of willful neglect. —*Reinder's Administrator* v. *Blick & Phillips Coal Co., Court of Appeals of Kentucky, 13 S. W. Rep.* 719.

Payment of Loss not Covered by Fire Insurance Policy.—An insurance company paid for a loss which it afterwards claimed was not covered by the policy and sought to recover it as paid under a mistake of fact. The following is the rule of law in the case: If the plaintiff paid to the defendant the money which it sues to recover after its agent had been to the place where the fire occurred and examined the premises, and was conversant with all the facts in the case, and nothing was concealed from him or suppressed or kept back by the defendant, and he was not misinformed or misled in any way, but acting with full knowledge, voluntarily paid or caused the company to pay, the company cannot recover.—*Nebraska and I. Ins. Co.* v. *Segard, Supreme Court of Nebraska, N. W. Rep.* 681.

Loss of Steamboat from Perils Insured Against.—A steamboat ran on a bar and after she was got off, the master, fearing that she would be lost from her leaks, ran her on another bar, when she became a total loss owing to the rapid rise of the river. This running on the second bar having been in good faith to save her, there was no negligence on the part of the master, and the vessel was lost by a peril of the river within the meaning of a policy of insurance insuring against perils of the river.—*The Natchez, United States District Court, Eastern District of Louisiana, 42 Fed., Rep.* 169.

Incorrect Diagram of Property Insured.—A solicitor of an insurance company secured an application for insurance, and with it forwarded an incorrect diagram. The solicitor was the agent of the company in obtaining the application, and if the diagram was wrong he knew it. The insured had a right to expect he would make a correct diagram, and the company cannot afterward defeat its liability by inserting in the policy a warranty which it knew to be false. *Spratt* v. *New Orleans Ins. Co., Supreme Court of Arkansas, 13 S. W. Rep.* 799.

Fixtures Put in by Tenant.—A landlord was requested to put in a new engine, but refused; he agreed, however, to let the tenant put one in on condition that it should belong to him. The tenant did not assent to this, but put in an engine in such a manner that he could remove it without injury to the building. The new engine did not become a fixture, but remained the property of the lessee. *Andrews* v. *Day Button Co., Supreme Court of New York, 9 N. Y. Sup.* 816.

FAMOUS AMERICAN ENGINEERS.

We have in the past few months made our friends acquainted with the personal appearance and professional records of many of the foremost constructing engineers of the country, and have to announce that we shall continue it in the next issue by the publication of the portrait of Charles E. Emery, Ph. D., together with a synopsis of his professional labors. We had hoped to publish every American engineer of note in the country, but we regret to say a few who were asked to complete our record in this line, declined upon the ground that they did not wish any publicity.

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If you do not think a locomotive does much work, get on one sometime laboring up a grade with forty or fifty freight cars behind. It is nearly an even thing whether the engine will pull the train, or the train will pull the engine. The two forces are so evenly balanced that there are but very few pounds in favor of the engine, and the wheels go round so slowly that it seems as though a child could hold the train with one hand. Bruff! bruff! the exhaust comes short and sharp, and the whole machine quivers at each stroke. On the footboard it seems as if her heart was being torn from her body; as if each exhaust would be the last, but when she finally "raises" the hill, and gets away with the train again, with all her limbs in full play, the exhaust says "that's enough of that, that's enough of that," and away she goes. A locomotive seems alive under its work, and it is no wonder that those who run them become attached to them.

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No matter what the intensity of the sun's rays the temperature of ice and snow can never rise above 32°. Hence the presence of ice and snow tends by direct radiation to lower the temperature of all surrounding bodies to 32°. In Greenland pitch has been seen to melt on the sides of a ship exposed to the direct rays of the sun, while the surrounding air was far below the freezing point, and a thermometer exposed to the direct radiation of the sun to stand above 100° while the air was 12° below the freezing point.

Foreign and Domestic Trade Literature.

THE ADAPTATION OF THE STEAM MACHINERY IN MARINE CONSTRUCTION. No. 4.

By Charles E. Emery, Ph. D.

The weights of the different items of machinery can be obtained, of course, by first making complete designs and taking each up separately, and working out the weight in detail. Such an operation requires a great deal of time, and will even then not be strictly accurate unless the machinery is finally constructed exactly in accordance with such plans. In designing the smaller government vessels it has been found necessary to obtain the weights approximately from a formula, making rather liberal allowances for the difference in design of different manufacturing establishments. A good approximation of the weights of cylindrical or Scotch boilers, 9 to 11 feet in diameter, to carry 40 to 60 lbs. of steam, can be obtained from the following simple formula:

Approximate weights, independent of water	$W_1 = 44.3\ d^2\ s.$
Weight of water	$W_2 = 25.7\ d^2\ s.$
Approximate total weight	$W_3 = 70.0\ d^2\ s.$

The first calculation includes the weight of grates, manhole, plates, smoke pipe, floor plates, and all appurtenances, and the result is, therefore, much greater than can be obtained from calculations from the drawing of the boiler. The formula should be distrusted, except for the particular conditions, and is approximate at the best. For a yacht, by careful design, the miscellaneous weights indicated above can be greatly reduced.

Formulæ for the weights of engines exist in nearly every manufacturing establishment. An old form of equation was: $W = A\ (d^2\ s)^{\frac{2}{3}}$.

The weight of some fore and aft compound engines designed by the writer for small seagoing steamers, including surface condenser, valves, pipe, shafting, propeller and all engine details, was represented by the results from this formula with $A = 92.4$. The dimensions of the large cylinder only were considered, the coefficient being sufficient to include the small one. Similarly, the complete weight of a single engine for 40 lbs. steam pressure was represented by the results from this formula with a coefficient of 75. The rule is based on the supposition that the standard weights in large engines are not as great as in small ones, and this was undoubtedly the case in the old practice. The writer has, however, found that large modern engines are being worked harder than formerly, and are being made heavier in proportion. So of late he has used a coefficient in units of $d^2\ s$ without the modifying exponent. The following examples, derived from actual practice, may be made the basis of obtaining approximate weights for entirely similar parts of substantially the same size, d and s referring to the diameter and stroke in inches. The diameter of the large cylinder only is used for a compound engine.

Weight of double 15″×15″ engine without condenser or pump	$4.03\ d^2\ s.$
Weight of single 36″×36″ engine, with surface condenser, shafting, and propeller complete—light	$2.08\ d^2\ s.$
Do. do.—heavy	$2.58\ d^2\ s.$
Weight of compound engine, 24 and 38×27 complete	$2.75\ d^2\ s.$

Weight of heavy cast-iron propellers, 6 to 9 feet in diameter, in pounds, 48 to 52 times the square of the diameter in feet.

Weight of jet condenser, 2.6 pounds per square foot of heating surface of boiler.

Weight of surface condenser in engine frame, 7.8 pounds per square foot of heating surface of boiler, or 13 pounds per square foot condensing surface.

It should be recollected that formulæ of this kind are only adapted for the particular conditions. Machinery designed for the smaller government steamers is very much heavier in proportion than that employed for steam yachts, and particularly heavier than that used for torpedo boats. It is necessary to provide for the revenue cutters, machinery which is reliable and operates at such moderate speeds that it needs but little attention. There is produced by the machinery of the larger cutters 4 to 5 i.h.p. per ton of weight, which compares well with the examples given for the English navy, considering the fact that small machinery of a given type, with an equal number of details, must in general weigh more than larger machinery. A cutter was, however, recently designed, in which 7½ horse-power were to be produced per ton of machinery, or about the same as in the average practice in very much larger steamers, but to do this it was necessary to use a special patented boiler. The precaution was taken of trying one of these boilers in a smaller vessel, and, although the same size had operated well in steam yachts, it gave so much difficulty under the conditions of government duty, that it has been decided to lengthen the new vessel in order to carry the increased weight of cylindrical boilers of ordinary type. In designing machinery for yachts the owner should be told that greater speed can be obtained by using lighter types of machinery, but that it would involve more skillful engineering to operate it and more frequent repairs, that he may judge, whether or not he will, in a certain sense, make his vessel a workshop, or be satisfied with slower speed to secure a type of machinery that will require less attention.

In preparing this lecture it was at first expected to state some of the rules used by the speaker in determining the sizes of the various parts of steam machinery, and to call attention to some precautions necessary in the preparation of specifications and contracts for marine construction, but the general consideration of the subject has occupied so much time that these further details must be omitted.

The most remarkable examples of high speed engines, when size is taken into consideration, are those of the new steamers of the Inman line built in Great Britain, but practically owned in America, the '*City of New York*' and the '*City of Paris.*' There are in each ship two triple-compound engines driving twin screws, each engine provided with three cylinders, respectively 45 inches, 71 inches and 113 inches in diameter with 5 feet stroke of pistons. The steam pressure is 140 pounds, and these engines have been driven continuously from shore to shore across the ocean at an average of over 86 revolutions per minute, or at a piston speed of 860 feet per minute, developing collectively an average of nearly 19,000 horse-power. The writer had the pleasure of being on the fastest ocean trip ever made, viz., that of the '*City of Paris,*' completed August 29, 1889, in which the time between Queenstown entrance and Sandy Hook lightship was five days nineteen hours and eighteen minutes. The engines were not stopped throughout the entire voyage, except to take on board the pilot, which occasioned a loss of 15 minutes, included in the total time. The speed occasionally fell to 83 revolutions per minute when cleaning fires, but soon afterward ran up to 88 and 90 revolutions, thus making the average as high as that previously stated. There is nothing so so much impresses a steam engineer as to see engines of this size running at the speed referred to. The weight of the cranks and connections amount to tons instead of pounds, and the distances moved through in changing the masses from one portion of the stroke and revolution to another are absolutely startling to those who think that number of revolutions fast even with engines of a few hundred horse-power. The successful operation of engines of this size at such a speed and at such a steam pressure is the most marked development of the progress in the construction of steam machinery, and reflects great credit upon the builders and the engineers in charge. At such steam pressures all joints must be absolutely perfect, by no means a simple matter in castings of such great size; the material must be the best that can be fabricated, and fully equal in unit strength to that of smaller pieces, a result not heretofore accomplished to any great extent except in the manufacture of heavy ordnance; and the tendency to heat and unduly wear the bearing has only been prevented by the employment of special compositions containing some of the new metals recently added to those available for the use of the mechanic, which compositions have been found by trial to run cool with heavier pressures and at higher velocities of the moving surfaces than others heretofore available. The difficulties attending the problem are emphasized by the fact that the '*City of New York,*' which is the duplicate of the '*City of Paris*' in every particular, has not yet, after running two seasons, been brought up to the speed of the '*City of Paris.*' It is claimed that there are no radical defects, but that the little difficulties which are continually happening with steam machinery have occurred and recurred at such intervals that the average speed is far behind, and the best trip made is only about the same as the best ones of the Cunard steamers, constructed several years ago, although Mr. E. J. Gearing, the former outside superintendent of the builders who fitted out the '*City of Paris,*' and remained with her until she had beaten the record, was early this season transferred to the '*City of New York.*' We have just learned that this vessel on her last trip, from New York, broke the crank pin of one of her engines the third day out, but kept on with the other. She made 433 and 434 miles per day the two full days before the accident, and made with one engine 375, 382, 352 and 316 miles during the four full days afterward. The round trip under these circumstances was made in 7 days and 56 minutes. The results show the great advantage of having duplicate machinery throughout, as, notwithstanding the accident, the vessel was not only entirely safe, but lost less than a day's time.

The uncertainty involved in attempting these high speeds is shown by the fact that the '*Teutonic,*' which it was expected would greatly outstrip all rivals, has not yet proved superior in speed to the '*Etruria*' and '*Umbria*' of the Cunard line, and although she has occasionally done better than the '*City of New York,*' she is still far behind the '*City of Paris.*' The machinery of the '*Teutonic*' develops less power than that of the '*City of New York*' or the '*City of Paris,*' the builders evidently depending somewhat upon the shape of the hull, which is longer and narrower than those of the new Inman steamers. The speaker believes that the chief difficulty is with the amount of power applied, and that the slight differences which can be obtained by changes in models, already good, can have no appreciable effect on the result.

(Concluded.)

WHAT DOES A STEAM HORSE-POWER COST? No. 5.

There can be no better example of Carnot's law of efficiency than in these two engines, and if the Corliss engine had coal at $2.25, its horse-power would be diminished inside of $6 for 3,080 hours, or one-fourth the other pumping machine; and if we consider the ratio of work done by 100 pounds of coal in proportion, the ratio of actual cost between the two engines becomes an enormous one.

WHAT DOES A STEAM HORSE-POWER COST?—NO. 7.

Using Back Pressure for Heating.

Cost of coal per ton	$4.60	$2.20
Coal per i.h.p. per hour, pounds	2.54	9.65+
Pounds of water per i.h.p., actual	26.28	72.
Evaporation of water per pound of coal	10.84	7.46
Initial steam pressure	104.6	94.6
Terminal pressure	24.6	57.6
Total i.h.p	542.	346.
Cost of one i.h.p. one hour for coal, mills	5.2161	9.5638
Cost of one i.h.p. 24 hours for coal, cents	12.518	22.95
Cost of coal for the whole load of engine one hour, cents	282.71	330.91

Pounds of coal per i.h.p. for 24 hours	60.96	231.6
Pounds of water per i.h.p. for 24 hours	630.72	1728.
Water in steam by calorimeter at boiler, per cent	2.36	1.94
Water in steam by calorimeter at engine, per cent	4.16	14.27
Water in back pressure steam by calorimeter, per cent	16.4	36.38
Percentage of total power in back pressure	20.	40.
Cost of 1 horse-power 308 days of 24 hours each	$38.55	$70.69
Cost of 1 horse-power 308 days of 10 hours each	16.48	29.45

The use of back pressures for heating is various as to appliances and purposes—an instance is shown between a Pennsylvania concern, with coal at $2.20 per ton, and a New England (mixed power) cotton mill using coal at $4.60 per ton, and nearly 100 miles railroad haul from water; the coal in left column costs over double that in the right hand one; both engines use back pressure, one to a reasonable, the other to an unreasonable,extent; the one has just double the percentage of back pressure in power to total load of the other engine. Both engines are nearly the same i.h.p. if back pressure was reduced, boiler evaporation quite in favor of the large engine, calorimetric conditions at boiler not in its favor, but at the engine twenty per cent. to its advantage.

There are many points of interest in this table over which steam users can ponder. One of them is that the value of the steam, as a means of doing its work again in boiling, etc., is not represented by the amount of water per calorimeter, but that that percentage is a reduction of "heat of vaporization;" or, to use Zeuner's formula, if we have steam at eighty-two pounds and 1.8 per cent. of water, we lose 95 heat units from each pound of steam, and 8 per cent. of water 148 heat units, and 12.6 per cent. of water in steam of 80 pounds=183 heat units loss. So in back pressure of ten and one-half pounds gauge pressure, we lose with 5 per cent. of water 116 heat units, and at 40 per cent. of water 431 heat units lost out of 1,141. The users of this "system" advocate latent heat in its entirety, forgetting that water present absorbs latent heat very rapidly. The calorimetric conditions between the two engines are very different in the three amounts cited, while the conclusion shows that the New Hampshire man pays over double for his coal, yet makes his i.h.p. at $16.48, while the Pennsylvania man's horse-power costs $29.45, with coal at half the money or, to put in another form, give New Hampshire his coal at $2.20 and he will make his i.h.p. for $8 against Pennsylvania's $29.45 or nearly, or in comparison, if both men used 1,000 h.p. under present conditions, New Hampshire would save a clear profit of $12,970 per year, or if Pennsylvania used 2,000 h.p. only, his coal alone would cost $25,940 more than the New Hampshire man's, and if the New Hampshire man had coal at $2.30, he would make his horse-power for $8.24 nearly, and save $21,210 on 1,000 *horse-power* over the Pennsylvania man each year.

WHAT DOES A STEAM HORSE-POWER COST?—NO. 8.

An Instance of Pumping Machinery.

Cost of coal, per ton.......................... $2 40
Pounds of water per i.h.p. of work per hour..815.82
Boiler pressure....................80 lbs. steam gauge
Initial pressure.......................36 lbs., absolute
Back pressure.........................21 lbs., absolute
Ratio of back pressure to whole load....78 per cent.
Steam engine required........4.7955 times the work
Work actually done.............6.5238 h.p. of steam
To do..........................1.36045 h.p. of work
Actual amount of water per i.h.p. steam, 170.52 lbs. per hour.
Water in back pressure varied from 21 to 40 per cent.
Cost of one i.h.p. one hour of work, cents....87.428
Cost of one i.h.p. 308 days of 10 hours each as one year..........................= $2,692.78
Cost of one i.h.p. one hour of steam,cents....18.322
Cost of one i.h.p. 308 days of 10 hours each as one year..........................= $564.32
One horse-power costs more than 75 h.p. Corliss engine, in ordinary circumstances, at........................$\frac{322}{1000}$ cents an hour.

So far nothing has been shown, but what a side-by-side comparison was made. In the data now on the screen (No. 8), an instance of how far men can and do go in machinery for using steam needs no comparison. With coal at $2.40 per ton, and 815.82 lbs. of water per hour for *one* single i.h.p. of steam. This is not by any means the worst case that could be shown, and the figures will bear thoughtful contemplation. The range of cost for an i.h.p. shown runs from $7.98 per year of 3,080 hours to $564.32, leaving out the one item of $2,692.78 for one i.h.p. of work for same time. The conditions in each case will account for all the difference. If time permitted, I could exhibit to you cases of locomotives blowing through steam two and one-half to four times what was necessary ; electric light and railway enterprises, with results that would make any man turn pale if his pocketbook was involved; steamships that are outlets for coal mines only, and other and curious facts. Steam will not be displaced under a few years. Compound engines using sixty to eighty pounds of water per horse-power, non-condensing, and twenty to thirty on ships, will not immediately drive out better work. The horse-power can be made by an admixture of brains in the coal for $8 for 3,080 hours, with Corliss 200 h.p. engine and a fair boiler, coal at $3 for 2,200 lbs., for twenty-four hours a day, $7.50; and in 1,000 to 3,000 h.p., coal at $2.20, and not over 12 per cent. refuse, $5.6 0to $6.20 a horse-power, if 144 hours a week, or $7 for 12 hours a day. —*Thomas Pray.*

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NOTES ON THE USE OF HYDRAULIC CEMENTS.

By A. Noble.

Although hydraulic cement enters into all important modern masonry structures, yet its qualities, its merits and defects are not always well understood even by those who have had considerable experience in its use. The engineer is often disappointed by an unexpected failure, and, it may be added, is sometimes surprised by the excellence of work done under conditions thought unfavorable.

In technical journals, transactions of societies of engineers, and elsewhere, the subject has been treated in various aspects, but the collection and weighing of information from these sources is difficult for the young engineer, and it is hoped that a few useful suggestions may be made within the limits of a short article.

Hydraulic cements in common use in the United States belong to one of two classes:

1. Natural cements—made from certain rocks by burning and grinding.

2. Portland cements—made by mixing clay and carbonate of lime in proportions found by experiment to be most suitable, and burning and grinding the mixture.

The ingredients of Portland cement are practically those which give natural cements the hydraulic property—the property which causes mortars containing them to harden or set under water. Portland cement of good quality contains a very small proportion of other ingredients. Its manufacture is constantly checked by tests of strength and chemical analysis, and may be called, fairly, a scientific operation. The rock from which natural cement is made may vary greatly in chemical composition and still furnish a hydraulic cement; mingled or united with the useful ingredients are others which are inert, and still others which are injurious, but which in the aggregate do not totally prevent the setting of the mortar; practically these elements cannot be eliminated, and it is easily seen that the product obtained from these defective materials must be inferior to Portland cement. Its manufacture cannot be checked readily by chemical analysis, for while it is easy to determine what proportions of a few useful ingredients will give the best cement,it would be a much more difficult problem to determine what proportions of other ingredients could be added without ruining it: the practical difficulty of applying chemical analysis usefully is increased by the fact that a layer of rock which at one point is useful may change its character within a few hundred feet and be inadmissible.

Portland cement being the superior in strength and uniformity would be used to the exclusion of natural cement were it not for its greater cost; the ratio of cost per bbl. varies from 2½ to 1 on the seaboard to 3 to 1 at inland points in the United States. It is obviously unwise to use the more expensive article where the cheaper one is good enough, and the engineer must decide which it is most judicious to adopt. A few cases in which Portland cement should be used may be mentioned: 1st, when a high degree or early development of the strength of the mortar is required; 2d, where uniformity is essential, that is, where an occasional batch of poor mortar would be particularly injurious, as, for instance, in a thin wall or a pier carrying a heavy load; 3d, to resist a head of water; 4th, in freezing weather.

Different cements vary greatly in regard to time required to take initial set; a very quick setting cement is sometimes essential in order that the mortar may resist within a few hours the action of the sea or of a current, pressure of water, or a heavy load. Unless the property of setting quickly is indispensable a cement setting slowly is to be preferred, because more time is given to mix and put in place in the structure before initial set occurs, and, because as a general rule, slow setting cements finally attain a higher degree of strength.

All Portland cements are expected to be hydraulic in a high degree. When first made Portland cement may contain particles of unslaked lime, and if used at once these particles will slake after a time, and, expanding, cause cracks in the mortar. Portland cement should therefore be exposed to the air for a few days after grinding so that the particles of lime may become slaked. This requirement is generally made in specifications for cement to be used near the factory, but is of less importance here because of the time required in transit across the Atlantic. Many natural cements are only moderately hydraulic, serving excellently where the structure is not to be put under water quickly.

The principal object of mixing sand with cement is to cheapen the mortar; at the same time it weakens the mortar, so that in determining proportions of sand and cement the engineer must keep in mind the requirements of the work. If mortar containing little or no sand be exposed to the sun for a few months it may disintegrate by the formation of small, fine cracks, dividing it into small pieces. Mortar for ordinary uses should therefore contain at least one part of sand to one part of cement.

When the proportion of sand to cement exceeds 2½ to 1 the mortar will be appreciably porous, because the cement will not furnish enough cement paste to fill the voids in the sand.

In preparing mortar the sand and cement should be mixed thoroughly and uniformly when dry; after adding the water the mortar should be made quickly, vigorously and thoroughly, and put in the work before setting begins. Mortar sets less quickly as the proportion of sand is increased.

For important work only high grade cements of either class should be used. The lower grades of Portland cement may give mortars stronger than those made with natural cement for a short period, but are liable to deteriorate with age and to injure or destroy the work. For such work cement should be tested, and the cost of the necessary outfit is quickly repaid.

Finely ground Portland cement will make stronger mortar when mixed with sand than the same cement if coarse. The difference is great enough to be of much practical importance, and fine grinding should be required in all specifications for this class of cements. With natural cements the evidence in regard to the importance of fine grinding is less conclusive, and it may be doubted whether very fine grinding is desirable, unless the ratio of sand to cement exceeds 2 : 1.

Mortars of most natural cements are injured if frozen before having set—particularly if this is followed by repeated freezing and thawing. Portland cement mortar is injured only slightly, if at all. Freezing is retarded or prevented in various ways: the stone, sand and water are sometimes heated, but this must be done with great caution, for the mortar will be ruined if overheated. Salt is sometimes added to the water used in mixing, lowering the freezing point of the mortar, and without injuring its strength. The resulting efflorescence on the face of the wall may be objectionable in appearance on architectural work.—*The Technic.*

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MAKING ICE AND REFRIGERATING BY MACHINERY.

The short crop of ice, owing to the phenomenally mild winter, has given quite an impetus to the manufacture of ice-making machines and mechanical refrigerators. These machines have attained great perfection within the last ten years, and are extensively used by hotels, breweries, abattoirs, packing houses and steamers, and, in fact, wherever the purchase of natural ice has become a prime necessity of economy. This season has more than doubled the demand for these machines. It takes about four months to turn out the larger ones, such as are used in breweries or large hotels.

In New York there is only one ice-making machine, and that is at Murray Hill Hotel. Another has been placed in the new Plaza Hotel. The former is a nine ton machine, with a capacity for making five tons of ice and thirteen tons of refrigeration in twenty-four hours. The new Plaza Hotel has a fifty-ton machine. The Murray Hill apparatus has connections with forty-four refrigerators covering a space of 13,000 cubic feet. To do this work costs on an average $8.10 per day, which includes everything pertaining to the machine, and this sum is equivalent to five tons of ice, while twenty-five tons would not perform the same amount of work. This machine cost $13,000.

Experiments in the refrigerating and ice-making line were made as far back as 1824 by John Vallance, and in 1834 by Jacob Perkins, but it was not until 1855 that results were produced which could be called practical. Professor Twining, of New Haven, had been experimenting with sulphuric ether between 1848 and 1850, and in the latter year obtained his first patent in England. Three years later he obtained the American patent, and in 1855 he operated a machine in Cleveland, Ohio, which was intended to produce 2,000 pounds of ice in twenty-four hours. The actual amount of ice it produced was 1,600 pounds. In this machine, which was only operated for two years, the "compression" system in use to-day is completely represented, and on this account Twining deserves the credit of not only being the inventor, but also of having carried it out in practice.

On account, however, of the inflammability of ether and other obstacles that this pioneer machine presented, inventors turned their attention to other substances better adapted to the purpose, among which were ammonia, sulphurous oxide, carbonic oxide, methylic ether, nitrous oxide, methalamine, and chymogene. Anhydrous ammonia, or ammoniacal gas, when entirely deprived of moisture, was found of all others to answer the purposes of artificial refrigeration. Its boiling point is 27 degrees Fahrenheit below zero at the pressure of the atmosphere, the gas producing sufficiently low temperature at a boiling pressure of 15 to 25 pounds per square inch.

In 1850, Dr. John Gorrie, of New Orleans, at the instance of some capitalists, conducted a series of experiments, the object of which was the generation of cold by the expansion of atmospheric air. At the time, however, the laws of thermo dynamics were not thoroughly understood. But it was proved by the mechanical theory of heat that under the most favorable assumptions the power necessary for the compression of a certain quantity of air in order to produce a certain amount of cold was far in excess of that which was needed if a liquefied gas or volatile liquid was used for the same purpose.

Not till 1858 was any progress made in the art of refrigeration. In that year, Ferdinand Carre, a Frenchman, proposed an entirely new plan of liquefying ammonia by using therefor the aqueous solution of this gas, 25 parts of ammonia in 75 parts of water. This is called the "absorption system." Carre's machine had its defects also, and inventors turned their attention again to the mechanical compression of anhydrous gas, which is accomplished by means of powerful vacuum and compression pumps, but the mechanical difficulties here presented are of such a serious nature that the absorption system still remains in use to a very large extent.

Ammonia gas is made from the refuse of illuminating gas water. The illuminating gas undergoes a process of washing before it will burn clearly, and the water through which this gas has been passed in order to be cleaned of impurities is aqua ammonia. This is distilled, the water taken out, and pure, dry ammonia gas remains. This gas is called hydrous ammonia. In this state it is used for freezing purposes. Because of its great evaporating capacity it is considered to be the most efficient agent for manufacturing ice. One cubic inch of ammonia gas in its liquid state is capable of expansion to eleven hundred times its original volume. One of the most effective methods is as follows:

The exhaust steam, after it has done the compressing of the ammonia gas, is utilized. This steam is passed through water to wash it, in order to take out traces of oil. The steam is then filtered and condensed into water again. The same water is used for cooling the compressed ammonia gas before the liquefaction of said gas takes place. After the water has been condensed it is never exposed to the atmosphere, but is kept in a system of pipes up to the time that it is filled into the moulds in which the ice is made. The water passes through the filter and condenser into a water regulator, and thence is taken into a deodorizer for the purpose of doing away with the unpleasant taste and smell of condensed water. This deodorizer is chiefly animal charcoal. From the deodorizer the water circulates through a system of pipes, and is cooled by the machine again to a temperature of from 32 to 35 degrees. Thence it enters the moulds. To freeze a block of ice, say of 300 pounds (11×22×24 inches in size), requires 60 hours of constant work under a temperature of about 18 to 20 degrees Fahr. It is necessary to freeze slowly in order to get absolute crystal clear ice. After being thawed out of the cans, the blocks, by means of a slide, are run into the storage house, where they are kept until put on wagons for delivery. The brine tank is made of iron or steel, and its size depends upon the capacity of the plant in which the cooling coils are kept. These coils are connected with the machine proper in such a way that the ammonia gas, after having taken up the heat of the water contained in the cans, is brought into the compressor of the machine, and is then re-compressed into a liquid. Ammonia gas in a compressed state only liquefies under a certain temperature, and therefore the compressed gas when it leaves the machine is circulated through a system of pipes called condensers, over which a continuous stream of water is run for the purpose of cooling them. The cost of the product depends entirely on the economical working of the machine and the proper application of its capacity.—*Progressive Age.*

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The average typewriter operator sets copy very much more correctly than the average compositor.

MACHINE DESIGN FOR STEEL WORKS.

One thing which caught my attention when I first began on machinery for steel works' use was the tremendous factors of safety and the enormous quantities of iron that were put into all the castings. It seemed to me that the country would be ruined if things went on that way long. But on going out into the works and seeing the machinery handled, especially the cranes, I wondered that iron could be cast thick enough to stand the pressure. The need of much common labor is an evil which a few of the best companies only are taking any extensive steps to root out. But in those companies labor-saving machinery is being devised for every purpose to head off the ravages of the "Polock" and Bohemian. But Rome was not built in a day, and at present we must raise our factor of safety high enough to withstand said ravages.

In roof and bridge work a factor of four or five is considered quite sufficient for any contingency that may arise. The chances of cases in which dangerous strains are set up in these structures are pretty well known, and to cheapen them some risk is taken—sometimes too much.

There is a Scylla and a Charybdis in the designing of every machine or structure. One of these is excessive cost, and the other excessive risk of breaking down. For different purposes these evils change their magnitudes to suit circumstances. There is a different end to attain in each case. A rolling mill and a bicycle should not be designed similarly with the same strains per sq. in. and the same care in finish. It is very important that a mill should always be ready to run; that it should be simple, and all its parts made of such size that the roughest usage will not prove injurious. A break down on a plate mill at a time when work is crowded, and there are many orders to fill, means sometimes the loss of two or three days. The heavy machinery cannot be handled quickly, even if spares are at hand ready to be put in place. The loss of the time, therefore, is of much more consequence than the loss of broken rolls or housings, and the reason why strains of only 4,000 or 5,000 lbs. per sq. in on wrought-iron or steel in tension and 800 or 1,000 lbs. or less on castings, are used in practice, become evident when the circumstances are considered. It is much cheaper, in other words, to put in the extra iron—costing but a few cents a lb. at most—than to save it scrupulously and lose thousands of dollars lying idle repairing machinery. As one of the great steel men in the country has said : "If you put in a few pounds too much metal you never know it, but if you don't get in enough you had better throw the whole thing away to begin with."

There is no way of calculating sizes in many places, and, for that matter, no necessity where experience has shown proper proportions. How can the strain on the housings of a mill be figured when a large slab gets stuck half way through the rolls and stalls engine and flywheel in one revolution? It is hundreds of tons probably, but we can only roughly approximate it. So too when one of the "pit gang" strips a hot ingot, and lifts it out to the surface, and then tips it over with the tongs still attached and lets it come down full force on the end of the jib of the crane, which is made so as not to notice that anything has struck it.

Cranes must be made so as to allow all sorts of accidents and carelessness. They must not be injured; for instance, if some sleepy Italian lowers the jib down into a pile of ingots. You can't make him be careful, so you must do the other thing—make the crane as accommodating as possible.—*The Technic.*

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According to naturalists, no animal is so stupid as the camel; he eats anything green, and when grazing, has to be accompanied by watchers to see that he does not eat poisonous shrubs.

GROWTH OF TRADES UNIONS IN ENGLAND.

A CORRESPONDENT of the London *Engineer* says: "In connection with the various Trades Unions' Organizations, the enormous growth of membership which has been going on during the past year is a matter which deserves serious consideration, as although the societies naturally congratulate themselves upon this apparent addition of strength to their ranks, it is not improbable that in the event of any serious slacking off in trade this largely increased membership may become a source of weakness. With the object of swelling their numbers, some of the societies have not been very particular as to the class of men they have admitted, and the result may be, that directly there is a decreasing activity in the workshops, large numbers of these men may be thrown upon the books of the societies for out-of-work support. The Amalgamated Society of Engineers has been making more progress than any other society in increasing its membership, and during the past month there has been a further addition of something like seven hundred members. The same thing is going on in smaller societies, the United Machine Workers' Association, whose annual report has just been issued to the members, having during the past couple of years more than doubled the number of it members, and during four years the society has increased from a membership of 370, with nine branches, up to a membership of over 2,000, with twenty-eight branches. With regard to the funds of the associations, it may be interesting to notice that the Steam Engine Makers' Society is now for the first time able to report a larger accumulation of funds in proportion to membership than the Amalgamated Society of Engineers, the declared value of the Steam Engine Makers' Society being now £3 10s. 4¼d., and of the Amalgamated Society of Engineers £3 9s. 1d. per member. The Amalgamated Engineers' Society at one time was able to declare a value of £6 3s. 5d., and the Steam Engine Makers of £4 1s. 4d. per member, so that both the societies have still a great deal to do in the accumulation of funds to place them in the same satisfactory position that the organizations occupied only a few years ago."

HINTS ON CONCRETE.

DYCKERHOFF, a well-known German authority on Portland cements, says in the *Deutsche Bauzeitung*, he considers that a comparatively small proportion of cement thoroughly incorporated with the sand and broken stone of concrete is more advantageous than a larger quantity less carefully mixed. For foundations he recommends the use of one part of cement to from six to eight parts of sand or gravel, or from eight to ten parts of broken stone. In cases where the structure is subjected to heavy shearing forces, these proportions should be somewhat reduced, one part of cement to from five to six parts of sand being then more suitable. In the case of very important work, Dyckerhoff recommends carrying out experiments to settle the proper proportion of cement to sand, employing in the experiments samples of the sand that will actually be used in the work, as sands differ so much in constitution that often a comparatively dull and bad-looking sand will give better results when tested in this way than sand of better appearance. In making the concrete the cement should not be measured, but weighed, as the weight contained in a measure varies considerably. In his own practice he uses as a unit a sack of cement, which is of invariable weight. The sand and cement are mixed and turned over three or four times with a spade before the water is added, after which it is again thoroughly worked till it forms a homogeneous and slightly damp mass. The broken stone, gravel, etc., which has been carefully washed and is still damp, is then added and the whole thoroughly reworked, so as to completely cover each fragment of stone with the cement, a point of the greatest importance. Workmen are deputed to prevent any of this stone working to the top during the transit from the mixing table to the site of the works, and equal care is taken in depositing it in the trenches, careful and experienced men alone being employed, as without this precaution the success of the work cannot be assured. To finish off the work he makes use of the cement mortar consisting of one part of cement to two and one-half parts of sharp sand, to which is added, if the sand is coarse, one tenth part of fat lime, which makes the mortar spread more easily.

AMERICAN LOCOMOTIVE BOILERS.

IT has long been known in this country that to get the full value out of coal there must be a brick arch in the fire-box. In railway work, as in other things, it is impossible to avoid the influence of ruling conditions. It is a condition that if a brick arch is used, the fire-box must be of copper; because, if a fair amount of work is to be got out of an engine, as little time as possible should be spent in washing out the boiler. Now, if the engine has a copper fire-box, the boiler may be blown out while the brick arch is still hot, and no harm will be done; but if the fire-box is of steel, it will certainly be cracked if the boiler is emptied before the fire brick arch is cold. But American engineers will not use copper boxes, preferring steel, and to avoid delay in washing out they give up the brick arch. We do not desire to assert that the proportions of American boilers are bad; but we do assert that the absence of the brick arch tends very powerfully to make them wasteful of fuel. This is a point to which we desire to direct the special attention of our contemporaries. We believe that they will find, on inquiry, that what we have said is substantially accurate, and that American engineers will admit, not only that the absence of the brick arch leads to waste of fuel, but that they accept the waste rather than submit to use a copper fire-box.

American engineers use an enormous extended smoke box to hold unconsumed fuel carried through the tubes. In this country we need nothing of the kind, because of the brick arch. With boilers of the proportions used in England we have no doubt that the economy secured by the arch is much greater than 12 per cent. It may, perhaps, be said that, after all, the cost of coal is a secondary matter; but even if we admitted this—which we do not—there are many other things to be taken into consideration. Let us, for example, suppose that of two engines, alike in other respects, one burns 33 per cent. more coal than the other. Let us call the first A and the second B. It is clear that if both engines exert the same power, the wear and tear of the boiler, fire box, grate bars, and fireman, will be at least one-third greater in the case of A than in the case of B. Furthermore, let us assume that the boilers are in both cases worked up to their utmost capacity; then B will be able to draw a 33 per cent. heavier train than A. To get more work out of A a smaller blast nozzle must be used to get a sharper draught, and this means more back pressure. It must never be forgotten that the steaming capacity of a locomotive is often as important as its economy, and the more water that a pound of coal can convert into steam the greater becomes not only the economical, but the actual efficiency; always provided, of course, that economy is not secured by making the draught suffer, a condition which, however, we need scarcely have named, as the brick arch does not hinder the draught.

As the matter stands now, we assert that the American boiler is not, as a matter of fact, as economical as the English boiler by 25 to 30 per cent., or even more. This fact is, we think, not disputed. Secondly, as to the reasons why, we speak with less certainty, and shall be glad to hear what our contemporaries have to say in the way of explanation. We have given our notions on the subject, based on statements made by American engineers in American technical journals and the "Transactions" of scientific societies. Perhaps our contemporaries will show that the American locomotive is better without a brick arch than with one, that it is better with a steel box than with a copper box. When we have heard what they have to say on this point we can go on to discuss other matters, such as questions of workmanship, the design of various details, and so on; but for the present we would ask our contemporaries to concentrate their attention on the broad fact that the American boiler is, from the economical efficiency point of view, deplorably bad.—*London Engineer.*

[We hardly think our contemporary has done itself justice. Brick arches are common enough in locomotives in this country, and reports of discussions upon them occur frequently in the Master Mechanics' Associations.—EDS.]

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FOR a new sort of steam boiler we hear that the chief advantage is that it is quite cold externally. It actually might be used in a parlor without overheating the same, says the inventor. This leads us to infer that the steam made by it is also cold, for all the steam we are personally acquainted with has been quite hot, and imparted its heat to the vessel containing it. A cold steam boiler certainly has its advantages in a parlor to those who wish boilers in such places, but we cannot see its particular value to the trade, unless, if the condenser gave out, it might be practicable to use it for both steam making and steam condensing, a sort of interchangeable quality which no one can say is wholly useless.

* * *

THERE is being constructed in this city a marine engine in which but one eccentric is used, this answering to go ahead and for reversing. The valve is an ordinary slide, and is given lap equal to the port opening, the single eccentric being set opposite the crank. The motion gives a very rapid and full opening, and has the dwell when the valve is open that is so characteristic and valuable a feature of the Corliss valve motion. We hope to illustrate it shortly.—*Boston Journal of Commerce.*

There are almost as many varieties of this sort of valve motion as there are patents on rigs to do away with cranks on steam engines. Most modern marine engines have but one eccentric.

* * *

THE new method of manufacturing articles from copper by electrical deposition seems to be attracting much attention in England, where the idea originated. There seems to be practically no limit to its application. Large tubes, vats, cylinders, and the like, can be made direct from rough copper far cheaper than by any other process. The electrical conductivity of the annealed copper is greater by 4½ per cent. than that of the best commercial copper; and the copper can be varied in tensile strength and ductility according to the requirements. The process is not confined to copper. It is equally applicable to nickel, silver or gold.

* * *

ALL sands taken directly from the earth and used for molding, contain more or less vegetable matter, which burns out so soon as the molten metal strikes it, making a rough, pitted and unfinished looking casting. In iron molding this is overcome by the use of facings; but the use of facings for brass molding is an impossibility on account of the necessity of preserving the natural color of the metal.

* * *

IT is rumored that a syndicate is forming to buy up the steamers '*Martin*' and '*Tremper*,' now plying between Newburg and Albany, and for the purpose of organizing an opposition to the Albany New York Day Line.

TRADE NOTES.

THE Singer Company, Elizabeth, N. J., state that they are going to make extensive improvements, including, it is said, the building of a large thread factory.

* * *

WILLIAM B. HAINES, of Melrose, died at Cardenas, Cuba, recently, at the age of sixty-one. Since 1858 he had made the trip to Cuba each year, and had become one of the best known engineers on that island. He was born in Stratham, N. H.

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MESSRS. CRAMP & SONS have forwarded to the Portuguese Government bids and plans for the construction of four steel cruisers for the Portuguese Navy. This is the first attempt of an American shipbuilding firm to compete with Europeans in building vessels for European navies.

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THE Pennsylvania Steel Company of Sparrow Point is rapidly completing its shipbuilding arrangements. The first contract has just been signed. It calls for the construction of a steel tugboat for a local firm. The company expect soon to enter the lists of bidding for Government work.

* * *

THE Board of Bridge Experts advertise inviting plans for the improvement of the bridge termini, asking that anybody who has been thinking up a scheme to improve and facilitate travel, to forward it to Secretary C. W. Buckholz, at the office of the BridgeTrustees in Brooklyn before September 1.

* * *

THE financial account of the '*Baltimore*,' which has just been closed, shows that the contractors have received $155,968.25 more than the contract price, which was $1,325 000. The extra sum was made by premiums amounting to $106,441.80, changes in the designs, $35,614.14, and the expenses of the trial trip, $13,912.31.

* * *

"I suppose," said the superintending engineer of a large steamship line in this port, "that I have sold over a ton of Dixon's Pipe Grease for the manufacturers by simply recommending it to others. It is the greatest stuff you ever saw for making pipe joints; beats red lead out of sight, and comes apart any time you want it, years after.

* * *

"THE total number of people injured by railroads in New Jersey during the year 1889 was 749. Of this number two-thirds were employees of the company, stricken down while in the performance of their duty." As there are only 3,748 miles of road, this gives one accident to every five miles of railroad, which is certainly a very large percentage of accident.

* * *

THE Ordnance Bureau is said to be entirely satisfied with the results attained at the test of the first of the four-inch rapid-fire guns built at the Washington Navy Yard. An initial velocity of 1,900 feet was obtained with a charge of twelve pounds of powder and a projectile weighing thirty-six pounds. The pressure was about twelve tons. The new breech mechanism worked altogether successfully.

* * *

THE Edison Industrial Works have filed articles of incorporation in the Essex County Clerk's office. Silver Lake is to be the principal place of business in New Jersey, but the company will have offices in New York and other States. The company is to manufacture, buy, sell, lease and use machinery for mechanical, scientific, mining and chemical purposes, and to purchase mines, factories and other property. The capital stock is to be $1,000,000, and the company intends to begin business with $150,000. Thomas A. Edison and Samuel Insuli of Orange, and Thomas Butler of New York, are to be the incorporators.

* * *

THE Globe Iron Works of Cleveland recently launched the '*Republic*,' their twenty-sixth vessel since 1886. The dimensions of this addition to the lake marine are as follows: Length over all, 308 feet 5½ inches; moulded depth, 24 feet 6 inches; beam, 40 feet; water ballast tanks, capacity 800 tons. Her engines are triple expansion, cylinders 24, 48 and 61 inches by 42 inch stroke, and two boilers of Scotch type, 14 feet diameter, 12 feet 6 inches long, with a working pressure of 160 pounds to the square inch. Her wheel is 14 feet diameter and 16 foot pitch, and her speed is estimated at 15 miles per hour. James Murray is the chief engineer.

* * *

SENSATIONAL articles have appeared in some of the New York papers in regard to the reorganization of the George F. Blake Manufacturing Company, to the effect that it has been bought out by English capitalists, etc. The actual facts in the case are as follows: Mr. George F. Blake, on account of advanced age, and Mr. E. C. Turner, who has been enfeebled by ill health for several years, have been desirous of withdrawing from the active management of the business for some time past. To extend the company's business in England and on the Continent, it was decided to interest English capital, and the result has been a complete reorganization of the company. The new company is capitalized at $2,000,000, common stock of which is controlled by the present stockholders of the company, the preferred stock and bonds having been largely taken up by the English interests. In the reorganization of the company, Mr. Max Nathan will take an active interest in the management of the company, together with Mr. George H. Stover, Thomas D. Blake, and the old corps of managers, superintendents, and assistants, as heretofore.—*Am. Machinist.*

* * *

A NEW automatic recording telephone system is to be had on the nickel-in-the-slot plan. When a per son wishes to telephone at a distance, on ringing up Central from the pay station, he will be told to place the proper amount in the slot. He will not be connected with the office he wishes to telephone to until he does so. As the nickel drops in the box it will he registered at the central office in full sight of the girl who has charge of the switch-board. The only coins to be dropped in the slot are nickels, ten cen pieces, quarters and half-dollars. When tried, these "automatics," as they are called, have given satisfaction. One has been working in the Hamilton building on Court street for a week.

* * *

THE Commissioner of Patents on the 13th of February rendered a decision bearing upon the inclusion in one application of claims for the method, and claims for the apparatus by which the method may be carried out. He holds substantially that, while separate claims may be made for product and process, there can probably be but one patent, and hence but one application should be required by the office. So, also, where some of the claims cover a machine and others a supposed process, the latter being merely the function of the machine, one application is sufficient to secure the invention and is exhaustive of the applicant's rights. The same doctrine is applicable where claims are formulated upon the same structure, some to cover it broadly or in a general form, while others are specific in character.

* * *

THE report recently published, that J. and W. Seligman & Co. and others had contributed to a large increase in the capital of Cramp & Sons, is confirmed by Jesse W. Seligman. The new capital at the command of the Messrs. Cramp would be about $5,000,000, instead of $3,500,000. Most of his associates in the enterprise, Mr. Seligman said, were Philadelphia steamship men, who would supply seme of the new business which the extension of the plant would make possible. "I believe there is a great future for shipbuilding in this country," he added, "and I am going into this matter for a permanent investment, not for a speculation." The Cramps are to continue their management of the business, and they are to have another shipyard beside the one now in use. It is said that the Messrs. Cramp have themselves put in a good deal of new capital, and that among the other subscribers are Thomas Dolan, a woolen manufacturer of Philadelphia; Clement A. Griscom, of the Inman and International Steamship Company, and John R. Dos Passos, who is to be general counsel of the reorganized company.—*Tribune.*

* * *

ORDERS for passenger coaches, freight cars and locomotives this year exceed anything previously known. The car works of both this country and England have all of the work they can do, and many of the principal factories are working large extra forces on extra time. The demand for freight cars is unprecedented, and it comes from all the trunk lines without regard to locality. The demand of the Western railroads for passenger coaches is greater than that of the Eastern roads. One notable feature of the manufacture of railroad cars in this country is the constantly-increasing call for them from European countries. American cars have been shipped this year to England, France, Austria, Spain and Australia. Mr. E. C. Jackson, the Wilmington (Del.) car manufacturer, in speaking on this subject the other day, said: "Our lumber gives us an advantage over European manufacturers. They have nothing for construction purposes like our white pine. Our styles of trimmings are far in advance of theirs, which look clumsy to an American. I think that is the reason that American manufacturers command favor when their work is once introduced in Europe. They do more delicate finishing than European workmen."

◆

THE charges for an electrical motor horse-power in Baltimore are as follows: 1-10 h.p., $2.50; ¼ h.p., $3; ½ h.p., $5; 1 h.p., $10; 2 h.p., $16; 3 h.p., $21; 4 h.p., $26; 5 h.p., $30; 6 h.p., $33; 8 h.p., $42: 10 h.p., $50. We presume there are some difficulties in arriving at the actual amount of power used by the consumer, and the possibilities are that he gets no more than he pays for. Unfortunately the circular does not specify for how long the charge is made, per day, week or year, but we believe it is the monthly charge.

HERE we have before us the reasoning of the wild electric crank upon the subject of electric locomotives, to wit:

> "Of the possible speed to be reached I will not attempt to say much. I do not think, however, that 100 miles an hour is at all out of the question, for, as we have seen, 90 miles an hour has already been made, and more than 80 is made for short distances by some of the regular express trains between New York and Philadelphia. But consider even what 100 miles an hour means: Starting from New York, Philadelphia before breakfast; going northward, Boston an easy morning's run; and, finally, perhaps Chicago a night trip. All this may sound fantastic to those of you who have not followed the electrical progress of the last year; but such developments are not only possible but probable. It is not so much a question of whether it can be done, as who will be the first to accomplish it."

Well, dear friend, when you consider that the fastest express trains in this country average only 45 miles per hour, most of them far less, you will see that you have lots of work before you to get along at 60 miles with electricity, to say nothing of a higher speed.

◆

NEVER hold converse with the daily paper reporter on the subject of steam, much less endeavor to explain anything to him. Here is what the reporter did to one man who tried to explain the action of a steam boiler to him:

> "The heating surface evaporates with a rate of 125 lbs. of coal per square foot of grate per hour, 6 lbs. of water per square foot of heating surface per hour, requiring only 5 square feet of heating surface per horse-power, on a basis of 30 lbs. of water per horse-power and per hour. The whole boiler contains 6,000 square feet of heating surface, and is of 1,000 h.p. One hundred square feet is the area of the grate surface, being in the ratio of 60 for heating to one of grate surface, thus reducing escaping gases to the lowest practical temperature."

Too bad, isn't it? Such an enormous consumption of fuel to such a small evaporation.

CLUB RATES FOR 1890.

IN former years we have made large reductions for clubs, varying in amount with the numbers sent. These rates have been lower than we can longer afford, and we feel that we cannot continue them longer. We hope our friends will feel that they get $2 worth of value in each issue, at least that annually, and continue their favors for 1890. We have therefore to announce that our rates for 1890 are:

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This is the lowest rate we can make for THE ENGINEER for any number of names. We add also that all names comprising a club must be handed in at one time; we cannot extend the privilege of joining a club at any time during the year to one or two persons.

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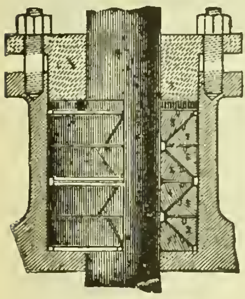

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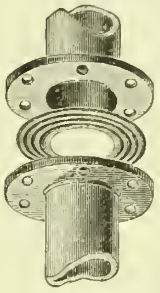

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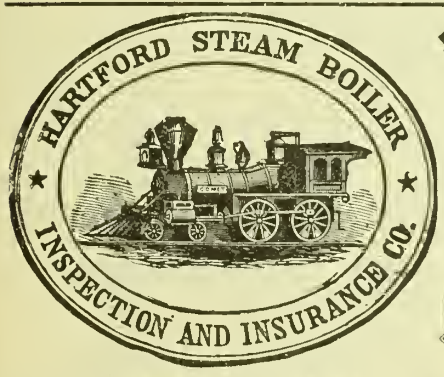

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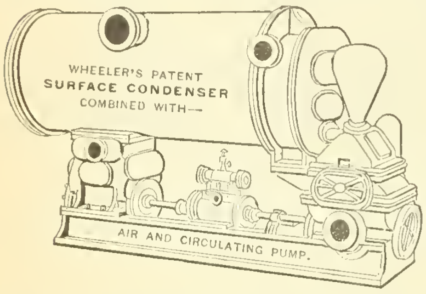
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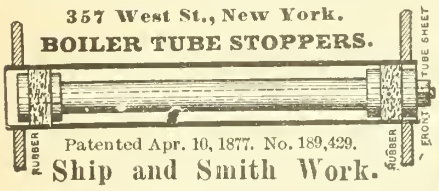

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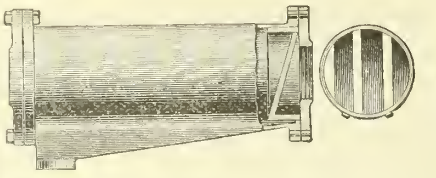

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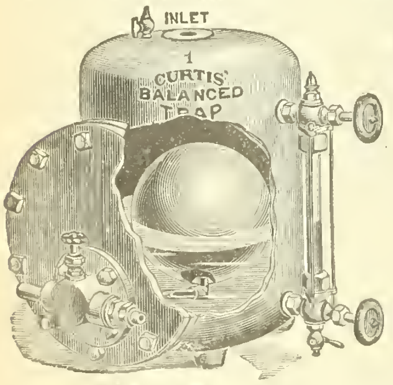

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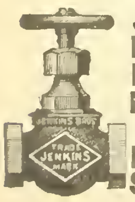

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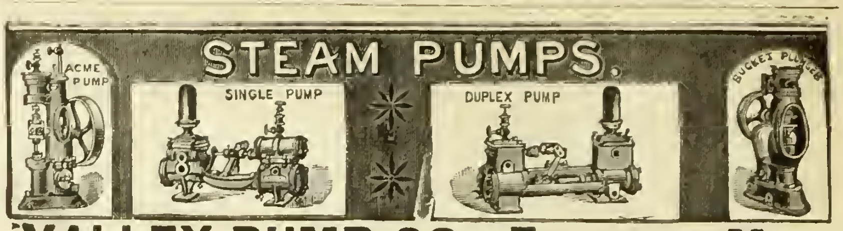

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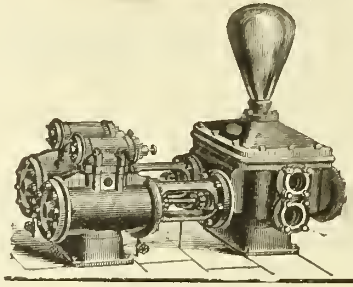

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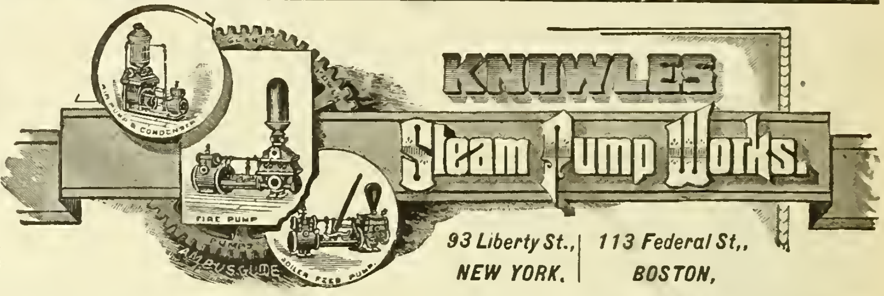

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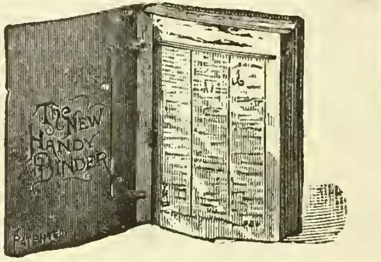

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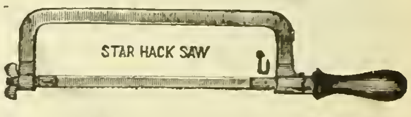

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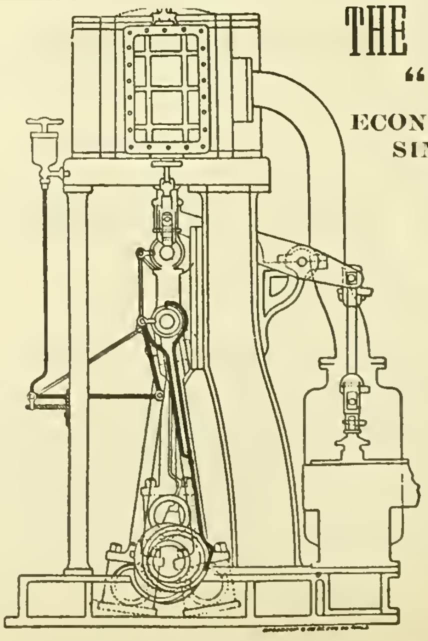

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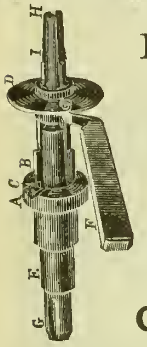

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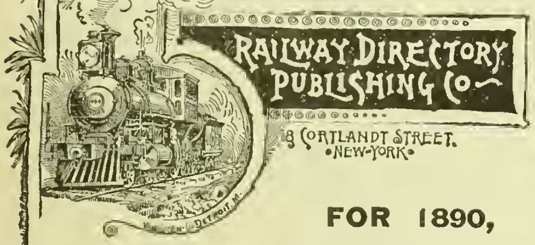
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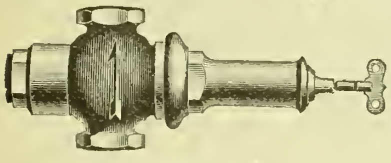

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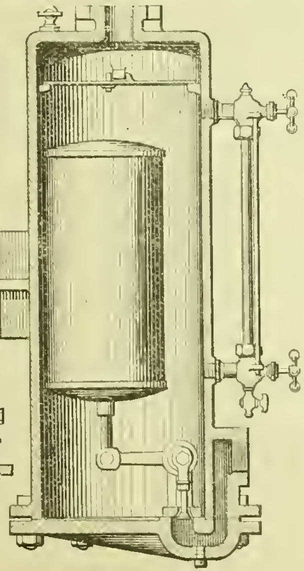

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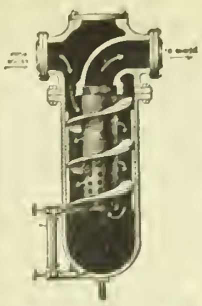

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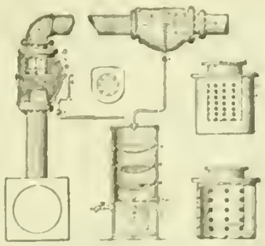

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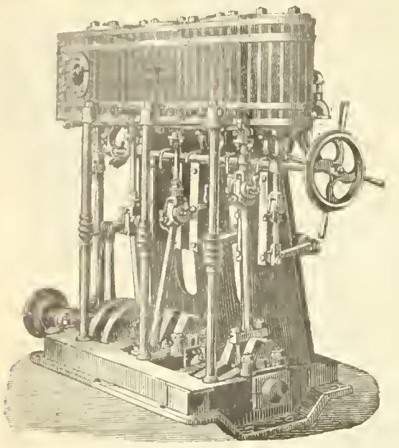

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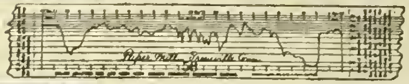

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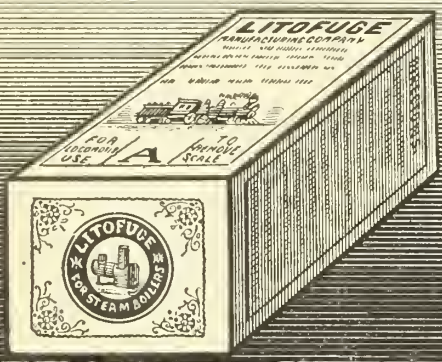

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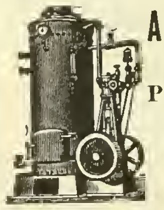

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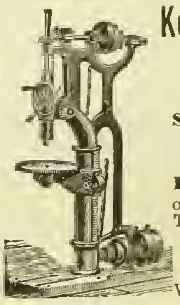

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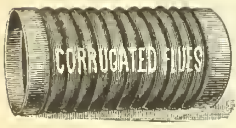

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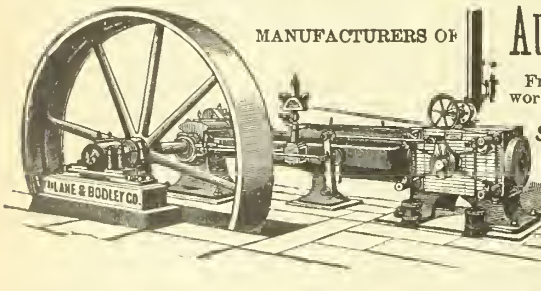
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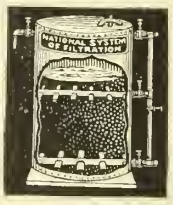

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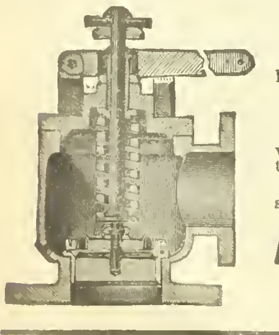

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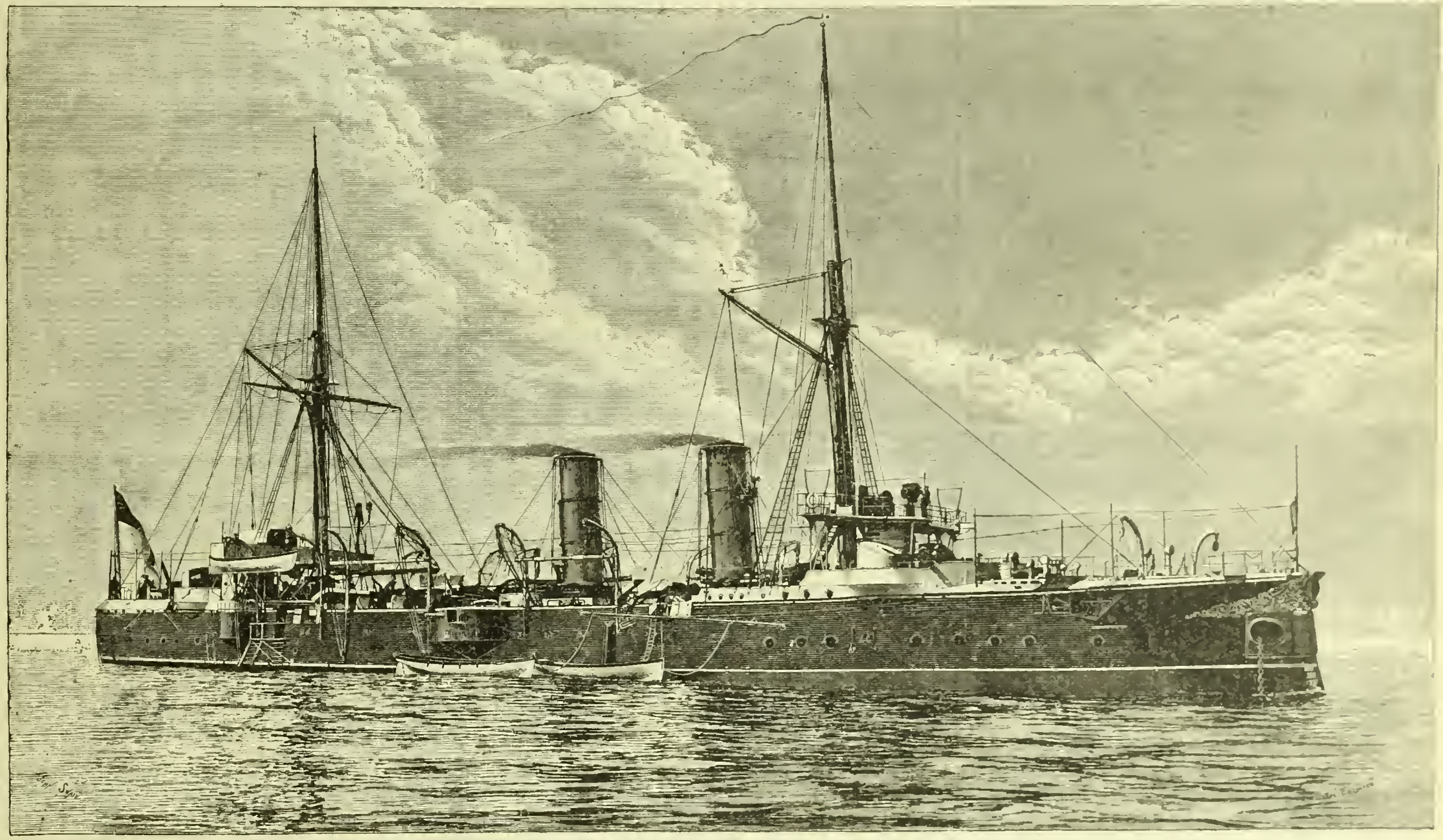

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Pattern-makers black varnish, thinned, makes a good waterproof ink.

TESTS FOR DRYNESS OF STEAM.

According to the researches of Professor Denton, of the Stevens Institute, Hoboken, N. J., when a steam jet is discharging freely into air from a nozzle, if a gap is observable between the visible cloud and the nozzle, then the steam is practically dry, and may also be considered practically dry even if the vapor is very faintly visible; but immediately it becomes distinctly white the water present has risen to from 1 to 2 per cent. These facts are most valuable in making rapid tests as to relative dryness, and the test is unexpectedly delicate. We were all in the habit of considering steam drier the more blue the appearance of the jet, but we were unaware of the accuracy of the test. A very good test for dry steam is the hand. Held in a jet of high pressure steam, if any water is present, it will be knocked out by the shock of impact, and be apparent. Dry steam of very high pressure does not scald the hand for a moment.

◆

Nothing in the world is so indestructible as a precious stone Time slightly affects its surface, and its size is so insignificant that without trouble it may be concealed, carried about, and even swallowed on an emergency. Unlike gold and silver, it is never worn away, or converted into currency, or beaten into the semblance of things in heaven or upon earth. A first-class ruby or diamond is about the nearest representative of an unchangeable object that it is possible to find in a world where, to borrow the words of Pliny, nothing is certain except that everything is uncertain.

A CASE OF "LEVITY."

Some years ago an esteemed foreign contemporary wrote us a private letter which sevely reprimanded us for being "funny," or indulging in humor upon technical subjects. It seemed to think this was highly derogatory to the dignity of the profession, and it concluded its homily by cautioning us not to do it any more. This extraordinary liberty with our affairs naturally surprised us, and as we could not see that we were so very culpable we paid no attention to our contemporary's order. We write this, however, to draw its attention as Censor General to the conduct of a prominent English journal, *Engineering*—no less—in publishing paragraphs upon technical subjects which have a markedly humorous tone, or, let us say, are intended to have. We submit one, in a recent issue of the journal named, in order that all may see what we mean It refers to the proceedings of the *American Society of Engineers*, a ponderous body which should not be made a butt of.

"The topical questions were then taken up. The first brought little information; the second, as to the greatest number of times per minute a dash-pot apparatus can be lifted, such as is used in the Corliss valve-gear, brought out a variety of replies; like a good fish story, the last man had the best chance, and starting at 100, the bidding finally reached 240, which ought to satisfy any reasonable man.

That evening was reserved for the chimney question. Professor Gale, from his name, was certainly entitled to a draught, and it seems as if his modest paper of the last meeting had exceeded the usual breeze and raised something of a cyclone. As this was a battle of the professors, and as some one at this meeting defined mathematics as an exact scientific language, it may be supposed that the thoughts followed this method of expression. The writer cannot say which one of the contestants came out ahead, but as Professor Wood's paper had the most formulæ in it, and the greatest number of sub-accents, it is probable his view is the correct one, especially as he supported the position of your great English engineer, Mr. W. J. Rankine. These four papers will make excellent vacation reading in hot weather and in a cool, shady place. If any one doubts it he had better make the attempt."

The correspondent of *Engineering* in this country is stated to be Mr. William H. Wiley, of the firm of John Wiley & Sons, New York, booksellers; his private address we do not know, but if our foreign contemporary deems it its duty to write him in regard to his fault we have no doubt but that a letter addressed as above will reach him. Observe the levity of the paragraph in question! Prof. Gale's name is made the subject of a feeble little joke in coupling it with "draught," "breeze," and "cyclone." We don't think he will approve of it, and this gives our contemporary some excuse for writing to Mr. Wiley. There is, also, in the lines above, an allusion to fish stories, which certainly have no connection with technical subjects—far from it. We could give other instances of levity in technical journals than the one above, and quote some very much worse, but we think this sufficient, and condole with Mr. Wiley in advance.

◆

A young man going through a course of electrical engineering at the Thomson-Houston Works, in Lynn, Mass., writes to his friends in Osceola, Fla., as follows: "Here I am at last. I started at work in the Thomson-Houston electric factory last Monday. To say I am surprised is putting it mildly. There are over 4,000 men employed in this factory. It is a good-sized town in itself. My first position is in the expert department adjusting and testing arc lamps. I am to go through a very thorough course, and be turned out a full-fledged electrician, but it comes very severe upon a lazy devil like me to go to work at 6:30 A. M., and continue until 6 P. M. But if others can stand it, I can."—*Scientific American.*

◆

Capt. James Rand, of the steamship '*Bluefields*,' has been presented with a gold watch for making the passage from Bluefields to Philadelphia in 6 days 2 hours and 47 minutes. Half of that watch belongs to the chief engineer of the '*Bluefields*.'

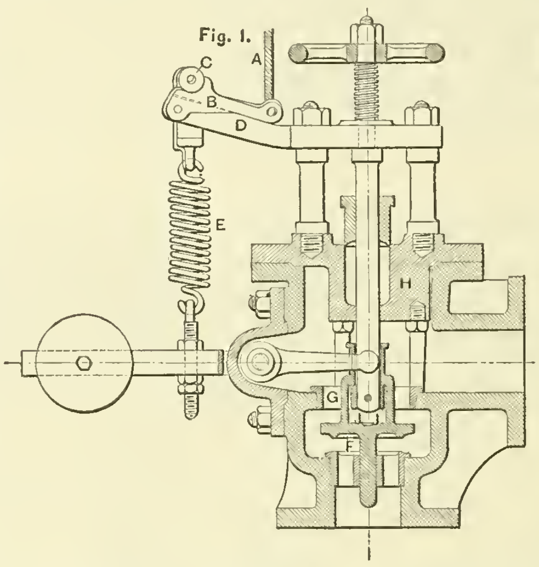
AUTOMATIC STEAM STOP VALVE.

The automatic stop valve shown in the engraving is designed to shut off steam in the pipe in which it is fixed, in case of a pipe bursting or of the engine racing.

When the automatic valve is fitted in connection with a land engine, the spring, *E*, can be adjusted so that the steam will be instantly shut off, should the driving belt break and the engine attempt to race. The screw for regulating the spring being outside the valve chest, the adjustment can be made with the greatest nicety, and all that is required to put the valve in operation is to screw down the valve a little to allow steam to get to the other side and thus restore the balance; then the valve will resume its proper position.

The automatic valve can be tested in less than one minute by pulling the cord, *A*, which is led to any convenient place where it can be easily reached. The lever, *B*, is lifted, and the small wheel, *C*, rolls off the arm *D*; this action at once detaches the spring *E*, and the valve *F* instantly closes against the upper seat *G*, which is not fixed, but removable for inspection or repair when the cover *H* is taken off. No part of the apparatus is liable to set fast, because all the parts work every time the valve is opened or closed during ordinary working operations.

Fig. 1.



The lever and cord detaching arrangement are only intended to be used for testing purposes, and in cases where an accident to the machinery renders it necessary to shut off the steam instantly by hand. When the spring is detached by means of the cord or wire communicating with the engine-room or other convenient place, the lower weighted lever comes into operation and shuts the valve at once, even in cases where there is no excessive escape of steam, such as is required to work the automatic arrangement. —*Engineering.*

◆

There was anchored in and about New York harbor last week the largest and most imposing fleet of American war vessels ever seen in this neighborhood. These vessels represented every class and every type of marine architecture known to the United States Navy of to-day, from the unarmored protected steel ship '*Baltimore*' to the torpedo boat '*Cushing*.' They included the '*Philadelphia*,' the partially-protected ships '*Chicago*,' '*Boston*' and '*Atlanta*'; the cruiser '*Yorktown*,' the double-turreted iron and steel monitors '*Puritan*,' '*Terror*,' and '*Miantonomoh*'; the wooden cruisers '*Pensacola*,' '*Essex*,' '*Enterprise*,' '*Galena*,' '*Kearsarge*' and '*Yantic*,' and the steel dynamite gun vessel '*Vesuvius*.' The ships together represent a displacement of 50,730 tons, and a main battery of 123 guns. Their main and secondary batteries likewise show every type of gun used since 1840, from the ancient muzzle-loading smooth-bore up to the high-powered breech-loading steel guns of to-day. The total horsepower represented by this fleet is 86,800.

AERIAL NAVIGATION.

It has been the hope of inventors for many years that the solution of the problem of aerial navigation would be accomplished by the cheap production of aluminum. The lightness and strength of the new metal have been thought sufficient to admit of an aluminum car being lifted by a motor whose machinery should be constructed of the same light material. We are not disposed to combat the view taken by a Mr Brock and others, but it is of interest to recall that it has been combated by a very ingenious and able thinker, whose argument is summarized in his own words, as follows:

"1. There is a low limit of weight, certainly not much beyond 50 pounds, beyond which it is impossible for an animal to fly. Nature has reached this limit, and with her utmost effort has failed to pass it. 2. The animal machine is far more effective than any we may hope to make; therefore the limit of weight of the successful flying machine cannot be more than 50 pounds. 3. The weight of any machine constructed for flying, including fuel and engineer, cannot be less than three or four hundred pounds. Is it not demonstrated that a true flying machine, self-raising, self-sustaining, self-propelling, is physically impossible?"

Professor Le Conte's argument, above summarized, is based upon the known fact that the largest bird weighs little if any over 50 pounds, and on the deduction therefrom that no flying animal can weigh much more above that limit. Professor Le Conte argues that as nature has not produced a larger bird, it follows that she could not, and he points to the ostrich and emu in support of his theory. They are too heavy to fly, hence their aborted wings. Regarding the motor employed in the flight of a bird, Professor Le Conte says:

"Nerve energy, acting through muscular contraction, and supplied by the combustion of foods, such as oils, fats, starch, sugar and fibrin, together form the most perfect and efficient engine that we know anything of, i. e., will do more work with the same weight of machinery and fuel." Moreover, this natural machine is its own engineer while "the flying machine must carry its engineer."

It must be conceded that the argument is a very strong one, but the day is apparently at hand when it will be quite possible to try a flying machine constructed in strict accordance with Mr. Brock's suggestions. We hope the test will realize all that is expected of it.—*Electric Power.*

[We see nothing to support the conclusion arrived at. We have been told that "the day is at hand" for at least a century. Yet there is not even an approach to a flying machine yet.]

◆

Under the head of "Costly Engines," the *Marine Review*, Cleveland, says:

"Just $735,000 is the price to be paid the Quintard Iron Works, New York, for the machinery of the '*Maine*.' The '*Maine*' has two propelling engines, one for each screw, and both alike. Each engine is of the vertical triple-expansion type, placed in a separate water-tight compartment. The cylinders are 35½ inches, 57 inches, and 88 inches in diameter, by 36 inches stroke, and are intended to work at 132 revolutions per minute at full speed. The calculated power of the main engines with the air and circulating pump engines is 9,000 h.p."

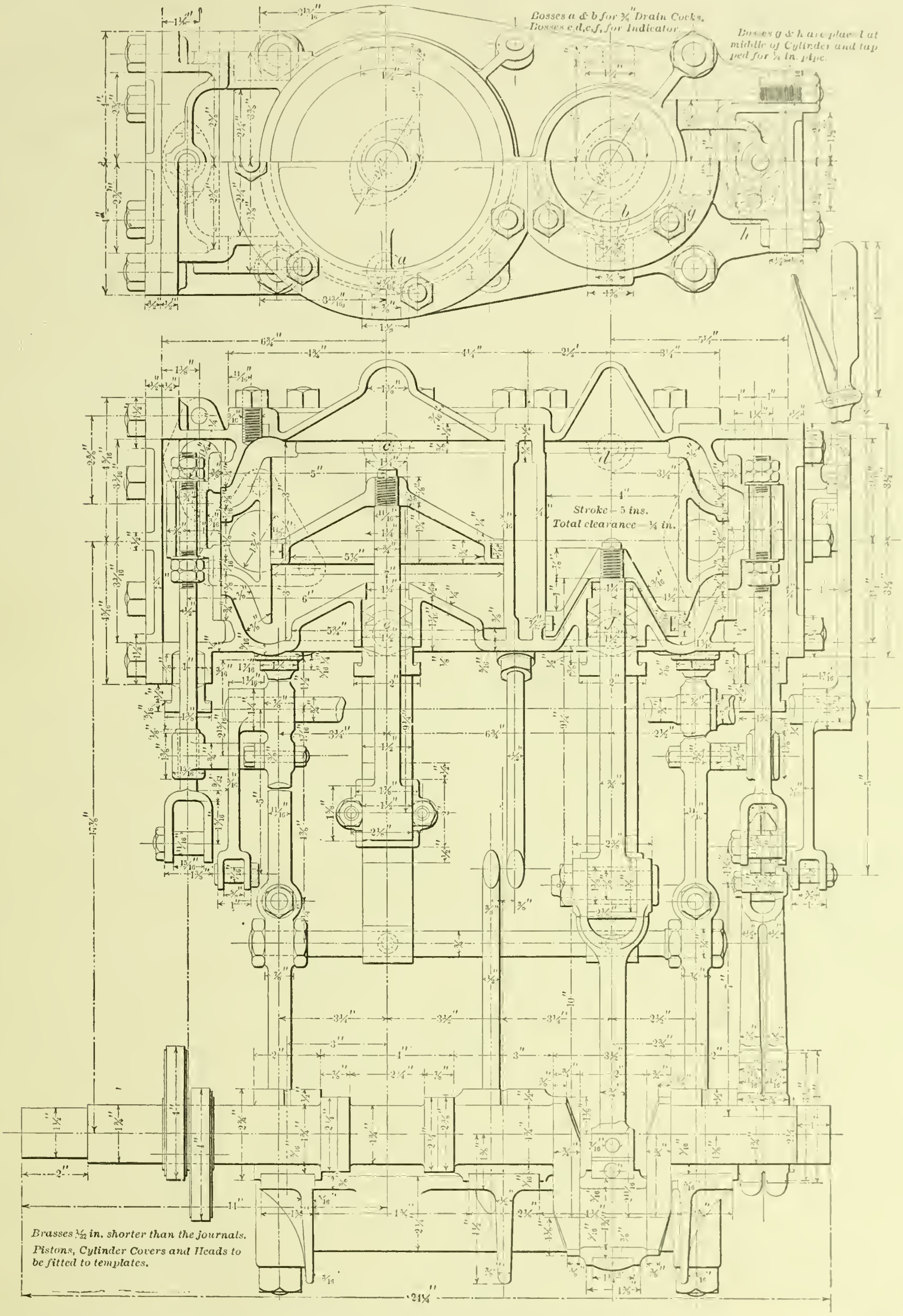
Well, friend, this is only $82 per h.p., not at all dear, considering the work upon them.

◆

In technical journalism one is often called upon to publish opinions and explanations, that however sound, are for the time unpopular. We have not refrained from candid comment on such things, and are perfectly willing to be judged by the blunders made when set against the foreseen results that have been predicted.—*The Journal "Industry."*

"We concur in the above.

The Bureau of Press Clippings sends us a circular asking us to pay them $40 per thousand for "items" which they think will be of value to us. As these items are the usual trash floating through the press of the country, they are worthless to our readers. In nearly all cases they are wholly incorrect on technical matters, and often culled from encyclopedias by sub-editors on a sudden call for copy. However useful they may be to politicians and actors, they are of no value to us. When we want sub-editors we will hire them ourselves. Moreover, the price is preposterous.


Bosses a & b for ⅜" Drain Cocks.
Bosses c,d,e,f, for Indicator.
Bosses g & h are placed at middle of Cylinder and tapped for ¼ in. pipe.
Stroke—5 ins.
Total clearance—¼ in.
Brasses 1/32 in. shorter than the journals.
Pistons, Cylinder Covers and Heads to be fitted to templates.
a
b
c
d
f
g
h
6¾"
5"
4"
2"
11"
24¾"

◆

Prof. Putnam, in his report to the Peabody Museum for the current year, says that man has existed for ten thousand years in this country.

COMPOUND LAUNCH ENGINE. No. 4.

By the Bureau of Steam Engineering, U. S. N.

The engraving in this issue represents a front elevation of both cylinders in section, showing every detail and dimension; also a plan of the cylinders in section. From these our readers will get a clear idea of the whole structure. Other details will be given in later issues.

◆

A first-class passenger train of five cars and a locomotive as it stands upon the track represents about $75,000. Put, say 200 people in it, and let it go at the rate of forty miles an hour, and then try to estimate the weight of responsibility upon the men who have it in charge.—*Locomotive Fireman's Journal.*

The coolest place where men do business in New York is the old Washington market. All the refrigerators in the market are cooled by the Cool Air Company. The pipes which lead from the central plant to the refrigerators run in every direction just under the roof of the market. On the warmest days these pipes are covered with snow half an inch thick. This cools the air around them, and the cool air naturally falls, thus cooling the entire atmosphere in the market.—*News Item.*

This would be very nice if true, but it isn't: the pipes are all lagged, so the market is a little warmer than the street.

◆

A vertical boiler 57 feet high and 12 feet in diameter was recently built in this city.

HONORS TO AN AMERICAN ENGINEER.

The memorial to A. L. Holley is to be erected in Washington Square in this city in October, and is to be made an event of much ceremony and importance. Unveiling the bust will take place; but the commemorative address of the occasion will be delivered, before the open air ceremony, in Chickering Hall, which has been engaged by the Institute of Mining Engineers for all the sessions of both societies in this city. Mr. James Dredge, editor of *London Engineering*, is to deliver the address. Besides his ability to grasp the subject, Mr. Dredge possesses a qualification which renders him welcome as well as competent. James Dredge was one of Mr. Holley's most loyal friends. It was at the house of Mr. Dredge that he was nursed back to life from the first attack of the disease, which after another year proved fatal. The occasion is an international one. The memorial itself is a testimony from engineers of both hemispheres. Its dedication will be graced with the presence of hundreds of guests from beyond sea.

◆

At the conclusion of his interesting and valuable article on "*The Adaptation of Steam Machinery in Marine Construction*," Charles E Emery, Ph.D., says:

> "The uncertainty involved in attempting these high speeds is shown by the fact that the '*Teutonic*,' which it was expected would greatly outstrip all rivals, has not yet proved superior in speed to the '*Etruria*' and '*Umbria*' of the Cunard line, and although she has occasionally done better than the '*City of New York*,' she is still far behind the '*City of Paris*.' The machinery of the '*Teutonic*' develops less power than that of the '*City of New York*' or the '*City of Paris*,' the builders evidently depending somewhat upon the shape of the hull, which is longer and narrower than those of the new Inman steamers. The speaker believes that the chief difficulty is with the amount of power applied, and that the slight differences which can be obtained by changes in models, already good, can have no appreciable effect on the result."

This is certainly sound from every aspect. The first essential in a fast ship is power, the second—power; and the third—power; first and last, power makes the ship go. We can drive a church through the water 20 knots an hour if we can make the church carry the power. Some of the models made half a century ago have never been improved upon. Make the screw turn up and the ship will go.

◆

A method of cooling and ventilating a theatre is in successful operation in this city. The arrangement is simple. In the basement of the theatre next to the air shaft is fixed a blower 8 feet in diameter. This instrument draws air from the roofs of the surrounding buildings and forces it into a great ice tank. Two tons of ice are in this tank, and as it melts the water trickles down over several corrugated iron inclined planes. The air strikes the bottom plane and winds its way up to the ice itself, getting cool as it passes. Reaching the ice it passes over that substance and through long ducts it is forced up under the auditorium. In each of the aisles of the orchestra, in the floor, are eight registers, through which this cold air rushes up. Its effect is instantaneous, and in order that the fresh air may be kept in motion a dozen or so large electric fans are placed on the walls. By actual measurement, after the system was fairly at work, it was 16° cooler in the auditorium than it was in the lobby, and the air was perfectly fresh. Two tons of ice will be used in cooling the theatre at each performance.

◆

An accident happened at the Housatonic Railroad round house in Bridgeport, Ct., recently, which is very suggestive. A Mogul engine was standing with steam up, when for some unexplainable cause it suddenly started. No one was in it or near it, and the big locomotive plunged into the turn-table pit and was badly wrecked. A leaky throttle valve caused the trouble, but suppose some one had been underneath, overhauling some part?

JAMES WATT'S WORKSHOP.

Watt's own workshop is at his residence, Heathfield Hall, nearly two miles from Soho. The old manor house stands in a densely wooded tract of nineteen acres, and was a quite pretentious building even in Watt's time. It is now converted into a mansion by George Tangye, Esq., who leased it about twelve years ago for a long term, giving bonds for the preservation of Watt's room, safe, intact, and without change other than required for its preservation. This room is in a wing of the building, and reached by a narrow stair and door that indicate seclusion. In this room, not more than twenty feet square, is a complete museum of models, machines, implements, and apparatus, employed by Watt in his last days, spent here in experiment and working. He died in 1819, after a short illness, and down to the last he permitted no one to enter as a matter of curiosity, or for any purpose not directly connected with his work.

He was a mathematical instrument maker by trade, and in that trade had acquired the art of tool handling and precision, while his experience as an engineer made him master of physics and forces, also of mechanical movements and practical affairs of every kind. We infer from traditions concerning Watt in his own neighborhood, that he was taciturn, abstracted, and petulant if disturbed; some evidence of this exists in a little shelf alongside the entrance to his room, where his luncheon was placed if he did not open the door when that meal was announced.

We had the privilege, through the courtesy of Mr. Tangye, to accompany him in exploration through this room about ten years ago, and regret that we cannot now give a tolerably complete description of its outfit. The amount it contains is enormous, and possible only by reason of the extreme order and careful arrangement of everything. There are from 50 to 100 trays or drawers, fitted into cases, and these trays subdivided by partitions so that each tool had its place. Taps for example, were not only each one in its place, but in many cases were wrapped in oiled paper. The diameter and pitch were indicated in each case, and the same rule applied wherever classification was possible.

The most remarkable thing of all was his "duplicating machine," one of his latest inventions, and the forerunner, in date, of a long list of carving machines, irregular turning of lasts, gunstocks, etc. The machine in Watt's room was especially adapted for carving and shaping medallions or relief work, and there is a bust on the machine partially completed, and just as Watt left it seventy years ago.

In the stove, an iron one of the Franklin pattern, are the embers of his last fire; on the top is a crucible that was being used for some purpose, and on a high shelf we came upon a meerschaum pipe, well colored. It was a curious, weird-like evening of adventure never to be forgotten, not only because of the associations, but because of the lesson in order and system that the workshop afforded, and in this trait we can see much that contributed to Watt's success. No one has ever seen much success come out of a "junk shop," a term that will apply to a good many shops of our day.—*The Journal "Industry."*

◆

The long-continued series of failures of machinery attending the new British warships leads an editor to think of keeping such a paragraph as this in type:

"H. M. S. ——— went out on ——— for her steam trial. At the end of the —— hour the tubes of her boilers gave out."

◆

The '*Carnarvon*' is a steam tender at Cape Town, S. A., and has two screws, one forward and one aft. She is 90 feet long by 13 feet beam, and she steamed 6,000 miles from England, where she was built in 1884, to her present location without accident.

ON DECK, THERE!

I remember when the evening came down dark, seating myself abaft the saloon for shelter from the wind which the steamer's progress was making to blow very nearly half a gale. An engine-room hatchway was directly in front of me, protected by gratings, and peering down, I could see through another grating into the black depths, a distance of forty feet beneath. There were scarlet lights at the bottom; the glow of one or more of the eighteen furnaces. You could see phantom figures moving, catching, now and again as they passed from darkness into darkness, a gleam from the fires that seemed to give them an outline of flame. The effect was extraordinary. Often voices broke into song down in those mysterious, resonant depths. The shoveling of coal was incessant. By listening a little you found words distinctly articulated by the engines. You fitted the rhythmic, metallic pulsations with syllables which became a sentence that was fast repeated over and over and over again. It seemed to me as though there were some mighty giant working below there in the fire-touched darkness you saw through the gratings; he breathed harshly and heavily, often with a fierce hissing through his clenched teeth, as though the burden of his tremendous labor grew too heavy for him, and he expended his impatience in a bitter sigh. There were a hundred sounds to suggest the presence below of some powerful human spirit, rather than the mechanical, soulless action of beams of metal and lengths of massive steel revolved by steam. It was the heavy panting that made you think of the hidden giant.

I listened to the sounds, human and mechanical, which rose through that engine-room grating as I would to expressions of a life utterly distinct from and wholly separated from our own. The gushes of air coming up through the hatch were unendurably hot. A whole forest of windsails swinging with distended arms in the gloom, like the sheeted figures of hanged men, carried the cool wind into the region of fire beneath: but the heat, as suggested by the fervid puffings rising from the engine-room, made one wonder how men could be found capable of discharging the laborious duties of firemen and trimmers, in an atmosphere of which the merest whiff snatched from the deck oppressed and enervated the whole system.

The stokers and firemen have the hardest times of it on board ship in these days, I think. Jack inhabits a fine forecastle compared to what he used to sling his hammock in in the old times of slush lamps, blackened beams, dripping carlines, and rats as big as cats. His food, if it be not better, is surely not worse than it was, anyhow. There is nothing particular to be done aloft, at least in such three-masted schooners as the '*Tartar*.' There is no deep sea lead to heave, and the duties of the sailor are restricted to cleaning, scrubbing, and swabbing. Besides all this he is in the fresh air when his watch comes round. But when I thought of the lot of the firemen, and of those whose day and night work lies in the engine room; when I contrasted the mild, delightful breezes I was breathing with that stagnant, feverish atmosphere where the fire god was doing his work: and when I listened to the incessant sounds of shoveling and the perpetual metallic roaring of the fabric of cylinders, piston-rods, crank-shafts, connecting-rods, and the like, revolving a propeller weighing eleven tons, I confess it was with amazement that I listened to the cheery and hearty singing of the poor fellows at their toil.

For it seemed to me that if I had to work in an engine room I should have but small heart to pipe out even the most lugubrious ditty I am acquainted with.—*W. Clark Russel.*

◆

Two more double end screw ferryboats are to be built by the Hoboken Ferry Company, of this city, similar to the '*Bergen*.'

"WORDS FITLY SPOKEN."

J. F. Holloway, Past President of the American Society of Mechanical Engineers, himself an engineer of credit and renown, was recently invited to address the engineer graduates of Stevens Institute. In a brief address he gave them a retrospect of the pioneer engineers of this country which is of interest to all. We regret that we cannot reproduce it in full.

"To tell you of the old-time country machine shop would be to occupy too much time, and as you will never look upon it you would not recognize the picture I might bring before you. Of the course of study pursued by the boy who wanted to be an engineer when I was young, I have to say but a few words. Counting the time occupied in building the kitchen fire in the morning in the home of the "boss," caring for his horse, and milking his cow, to the time when the hour of nine at night rang out from the village church, and we blew out our dim, smoky lamps, and stumbled over the castings and rubbish with which the shop floor was strewn in our eager haste to get away, we had worked long hours, the eight hour system not having at that time been invented. There were then and there few opportunities to learn by observation even, for while our shop was as good as any it was primitive enough in its architecture, its general arrangement, and especially in its tools. Were I to tell the class of Mechanical Engineering of Stevens Institute of the big bull lathe of which we boys knew so well, and were so proud of, what I would say would convey to you but little meaning. Should I undertake to describe its wooden ways, with a little strip of flat iron let into the top of the heavy timbers, and the blocks we used to put under the head and tail stock to raise them up when we wanted to bore out an extra large gear wheel, of say four feet in diameter, I am sure you would not know what I was talking about, or if I should attempt to describe the hand tools with which our oldest jour. turned cast-iron shafts and gudgeons in this lathe, I am confident it would all be Choctaw to you. Your teachers have never described such tools to you, your books do not contain illustrations of them, and in your workshops and cabinets I see nothing to hint that they ever existed; and so it would be of our upright drills, our makeshift tools of all kinds—they are of the past, and their use a forgotten art. You will find in the literature of to-day a good deal is said about 'the rule of thumb.' It has served as a basis for many a jest, and as a text by which to show the vast superiority of the present over the past. But I am talking to-night of the old-time workmen who had few or no tools; I am speaking for the dead and gone engineers, who, with their native good sense and active brains, supplemented with skillful hands and the traditionary 'thumb rule,' did accomplish ever so much for their day and generation. As compared with the micrometer measuring machine which stops not short of registering the one-tenth of one-millionth of an inch, or the Vernier calipers whose thousandth of an inch is common every day practice, a flat, wide thumb, grimy with toil and hardened with use, sliding up and down a well-worn two-foot rule on which the sixteenth marks were worn off, and eighths but dimly seen, the rule of such a thumb does not seem to be strictly accurate, or fairly infallible; and yet, it was with such a thumb and such a rule that George Stephenson built the '*Rocket,*' Whitney made the cotton gin, McCormick cobbled up a grain reaper, Fulton an engine, and Evans a steamboat; it was by the 'rule of thumb' and few tools, the first ideas of machines that have since revolutionized the world were molded into shape, and started on their subsequent career of prosperity. There is, however, one thing that should be borne in mind, it does make a vast difference whose thumb it is that makes the rule or molds the machine.

"In the West, or what was the West when I was a boy, a good deal was said about a sixth sense; it was there called 'horse sense.' I do not find that in the list of studies as pursued in the modern schools, that there exists a professor of 'horse sense'; perhaps such teaching is not now necessary, but it was a great aid to the young chaps who years ago wanted to be engineers, and could find no schools of engineering to go to. The possession of this sense, whether acquired by experience or observation, or the result of natural instinct, was of great value to a young man when, as a 'cub machinist,' he had brought to him a job to do, the like of which he had never before seen, and for which there were no special or even suitable tools. It came into excellent play as he stood and looked over the work to be done, and, unaided, puzzled himself as to how he should go about it.

"Many a time have I seen him pull out his worn rule, slide it over the job before him, then chalk a few figures or a sketch on the vice bench, contract his brow, scratch his bent-down head in deepest thought, until suddenly there would come to him, like a revelation, a gleam of satisfaction that would light up his face, smooth his furrowed brow, and he would start out to scan the array of old and odd things with which the shop walls were adorned, would tumble out the accumulated scrap which had found refuge under the vice bench, would dig to the bottom the old scrap pile in the corner which had in it a little of everything, selecting from one place an odd gear wheel, a crank handle from another, to which he would add a short shaft, or a long screw, then with the aid of the carpenter, a lot of blocks and a few planks, bolted together with long bolts made to do duty as short ones by the stringing on them of old nuts slipped to do duty as washers, he would rig up a jigger on some worn out lathe, the like of which had never before been dreamed of. And all this under a sharp cross-fire of wit, puns and queries from his mates, who discussed with each other across the shop, in terms and tones meant for his ear, their ideas and imaginings as to what the 'cub' was up to, and what he would have when he got through. I have seen, too, the culmination of his improvised contrivance, which, tied up with ropes and hitched up with odd pieces of old belts, when started up, did just what the young genius who had gathered them together expected them to do. And I have seen this possessor of 'horse sense,' with illy-concealed pride, walk up and down the shop floor with his hands in pockets, whistling softly to himself, while his shopmates gathered around his conglomerated machine, whispered to each other in subdued tones: 'By gosh, she goes.'

"As I have previously said, possibly with the wonderful advance in the art of machine tool construction, this kind of 'horse sense' is no longer essential; but after all, it is the province, or should be, of colleges, and technical ones especially, so to train the minds of their students as that, not relying on theories or formulas alone, they will so use them in connection with thought, as that they shall become aids only in the accomplishment of what comes before them to be done. I cannot conceive of any education that can supplant thinking in the making of a successful engineer. To think, think, think out a problem, is the only true way to successfully solve it. Nothing in the profession you have wisely chosen can ever take the place of hard thinking; schools, laboratories, libraries, lectures, and such shop practice as you may have had, will be of most valued aid when supplemented by hard thinking. I do not believe all the theories in the world alone could teach one how to drive a nail. Nothing but practice will do that, and even practice without thought will not accomplish it; you must have both combined. When you drive a nail in a board, what do you do?

Do you trust to luck that the swinging hammer above your head shall come down on the right place? No. Do you concentrate your thoughts on the hammer circling in the air? No. You concentrate your thoughts and eyes square on the head of the nail you want to hit; and no matter where your hammer is, or what curves it describes in air, if your intense thought is on the spot where the blow should fall, there it will fall; if your thoughts wobble and are uncertain, you will miss the nail or knock it sideways. Did you ever see ranged about an anvil a half dozen stalwart strikers who were called up to help the head smith draw down a large shaft, or make a heavy weld? If so, you have seen them ranged in a semicircle before the anvil, each with his sledge hammer poised in the air awaiting the nod of the master, smith, who, with a small hand hammer, strikes a light blow where he wants the first sledge to strike, and as each swinging sledge falls in rhythmic sequence on the glowing iron, they each fall in the very spot where the hammer of the head smith has last struck, and why? Because each successive striker has fixed his thoughts upon the spot indicated; and as the finished task lies cooling on the earth-trodden floor, shaped and completed, it is a beautiful example of what concentrated thought, aided by muscular energy, can accomplish. And so the man who never had a chance to go to an institute of technical culture, and who, late in life, was asked to say something to a class of engineering students who, more favored, did go to such an institution, and who for want of that early training may have said to-night many things it would have been better not to have said, desires to add but a word more to those he has already spoken, and that is: Prize highly the opportunities you have here enjoyed; they will be of great value in the future if rightly used, but great as they are, they will not lead you to success if you do not have something of the patience, perseverance, industry and pluck which alone was the training, and the patrimony, of the engineers who graduated from out the country machine shops of long ago.

◆

The Revenue Marine officer has neither the advantages of the civil nor those of the naval employee of the Government. The former works usually in the daytime and at fixed hours; the rest of the time is his own and he lives at his home. His pay goes on in sickness, and he has a vacation each year without forfeiting any salary. The Revenue Marine officer must face the dangers of the arctic seas and tropical pestilence, as well as of the storms in which he is called upon to save life. He is cramped on shipboard, where he serves night and day, and his pay is cut down both for sickness and for absence on leave. On the other hand, the naval officer, while sharing the hardships of service afloat, receives larger pay in the same rank, can attain higher rank, has no deduction for the leave of absence to which he is entitled, has longevity pay, enjoys the advantage of trial by a court of his peers if charged with shortcomings, and can retire on comfortable pay in his declining years. If such advantages could be assured to the Revenue Marine officer without the transfer to the navy, he would presumably be well satisfied. But experience shows that Congress is not willing to make such precedents for employees in the civil departments.—*N. Y. Times.*

◆

In a review of a work on slide valve-gears in the *Franklin Institute Journal*, the reviewer, who appends his initials only, H. W. S., says:

> "In the preface, the comparison made between the Zeuner and the Bilgram diagram is simply an evidence of the fact that the author does not know what he is talking about."

Go softly, H. W. S.; a man never loses anything by putting his thoughts into polite forms of speech.

◆

C. D. Mosher, builder of the fast steam launch '*Buzz,*' has completed another vessel which is much faster. We shall illustrate it shortly.

THE ENGINEER.

FORTNIGHTLY. - - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK, AUG. 16, 1890. No. 4.

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THE AMERICAN CRUISER 'CHICAGO,' U. S. N.

THE '*Chicago*,' U. S. N., excited nearly as much adverse comment upon her advent in 1884 as the '*Dolphin*,' U. S. N., and there were not wanting many who declared that she was unseaworthy by reason of her "peculiar" engines and furnaces. Controversies and communications filled the daily papers, and the "Naval officer of long experience" (without any name) was frequently quoted as adverse to the '*Chicago*.'

There is nothing peculiar about the '*Chicago's*' engines; they are beam engines, designed by a civilian engineer, Miers Coryell, and built under his supervision, with some alterations for which he is not responsible; the brick furnaces are not new as to their inception, but are new in design and application on an extended scale to a naval vessel, and these also originated with Miers Coryell. Basing our faith wholly upon his professional sagacity and good judgment—after an acquaintance with it extending from 1851 to the present day—nearly forty years, we said, in 1884—that if the '*Chicago*' was given a fair trial upon her merits she would prove one of the most valuable ships in the navy; how near our prognostications were to the facts let the following report of the '*Chicago*,' on her return from a year's cruise, answer:

> "From the time that the flagship '*Chicago*' left this port, Nov. 18, until her return, July 30, she has sailed 16,180 knots, her screw making 4,298,733 revolutions, all told. In the nine months of her actual sea service she has met with only one serious mishap, the dragging of her anchors off the island of Corfu, in the Mediterranean, last April. While riding in a comparatively secure harbor, and in smooth water, a sudden stiff puff of wind caught the flagship abeam. She dragged her anchors, drifted alarmingly near the beach, and was in real danger for a few moments. Unfortunately both engines had been taken apart. To get up steam and sheer off was impossible. There followed a moment of great peril and excitement. But the reliable points in the construction of the flagship soon showed themselves. It chanced that there was just enough steam on the auxiliary engine (which is always in use for running the dynamo) to turn the screw. This was promptly resorted to, and at the same instant another anchor was let go just in time to see the '*Chicago's*' stern narrowly scrape the beach. In seventeen minutes the main engines were in order and steam filled the boilers. This accident was the only one that has visited the '*Chicago*' throughout the cruise, save the mishap in the harbor of Lisbon last winter, when owing to a defective shackle she lost a large seven-thousand-pound sheet anchor and fifteen fathoms of chain. The engines were stopped unexpectedly but once, when it became necessary to pack a stuffing-box."

How is this for the despised beam engine and the "dangerous" brick furnaces? There is not a word said about these last. If they had given the least trouble there would have been plenty said. The success of the '*Chicago*,' and of later vessels built by American engineers and naval architects, proves what we have always asserted—that we do not need to go abroad for plans of any kind, naval or commercial.

QUEER THING TO KICK AT.

IN the press dispatches of the day comment is made upon the weight of the bill Uncle Sam had to pay for the trial trip of the '*Baltimore*,' U. S. N. Our worthy Uncle was let in for it because the vessel achieved more than her contract speed; but he did not like the size of the bill because it had very much more area than he expected. We think our esteemed relative is very unreasonable. There is nothing the matter with it that we can see. Everything must be in keeping in this world, and if we have high power cruisers we must expect the trial trip bill to be high power too. It occurs to us that if the contractors had lost, and had been obliged to foot the bill themselves, the amount would have been just the same, for they could not very well adjust the bill to the occasion, particularly when they were not quite sure of the result. Objection is especially made to the commissariat items which Uncle Sam says were very large indeed. We hope they were very large—as large as possible. Upon trial trips of this kind men have to do the largest kind of work in the smallest space of time, and they need to be thoroughly braced for their duty. Uncle Sam has plenty of money, and he has no call to kick for a trifle like the one alluded to.

PRECEDENTS FOR HIGH PRESSURES AND SHORT CUT-OFF IN ONE CYLINDER.

WHAT we call facts in engineering are sometimes mere assumptions, and are contradicted by the experience of others. A fact is only established when no other evidence can be produced to refute it. It is a palpable fact that there is a sun in the heavens, and, in engineering, many things are stated to be facts and argued from as stable standpoints when they are not facts to those who know both sides of the question. For instance, the opponents of single cylinder expansion engines always assume that it is impossible to carry high pressures and cut-off short—expanding in one cylinder—on account of the racking strains set up, the unequal pressures on the crank pin, etc., etc. Now this is an assumption pure and simple, for there are marine engines which have been running for years, doing this very thing. The late Captain Ericsson built a stationary engine in the last years of his life which used steam at 200 pounds per square inch—higher occasionally. This engine had a valve motor which was exactly like the action of the trigger of a gun; it snapped the steam on to the piston instantaneously, and cut it off just as quickly; yet both of these engines, the marine engine and the stationary engine, work perfectly so far as mechanical action goes; so far as economy goes there are no engines to-day which can surpass them. The marine engine mentioned is in the Ss. '*Hudson*,' running in the Cromwell line between New York and New Orleans, designed many years ago by John Baird, one of the ablest marine engineers and naval architects we ever had in this country. The action of the '*Hudson's*' engine is all that could be asked, yet she uses steam at 90 pounds per square inch cut off at $\frac{1}{16}$th of the stroke; piston 60″×5′ stroke, revs. 70 per minute; her repair account is nothing to speak of, while her economy is as high as any two-cylinder engine. From this it would appear that precedents are not wanting to establish the fact that steam of very high pressure may be instantaneously admitted to a piston without any injurious effect.

THE REASON WHY.

We find in a daily paper—the New York *Press*—this remark:

> "Thirty years ago there were great names in journalism. Where are they to-day?"

And in the same paper, in another part, this:

> "They are going to plant clams on the coast of England. We have no objection to their taking New York's Four Hundred as the first seed."

Perhaps the second paragraph answers the first question: if it does not, we will give the answer. The reason that there are no great names in American journalism to-day, is because there are no great men. The daily paper of to day is prostituted to money-getting, and is a sensational unreliable scheme, managed for the most part by the baseball, horse racing, political-leader part of the community, or in their interest, and caters to the lowest tastes. If it does not, it has no existence. Quality of matter has given place to quantity of matter, and an issue of one of the so-called "great dailies" is tedious to go through. Discussion of questions which interest thinkers is not tolerated, the editorials, so called, being mere rubbish, touching on the chances of McGinty, or the moral turpitude of McGonigle. In other respects the idiotic paragrapher has full sway, and the rot that is printed as humor is simply appalling. The result is that the daily paper is hastily scanned for current events and speedily thrown away by people who have a taste for matter which is not merely prurient and sensational,

FAMOUS AMERICAN ENGINEERS. No. 11.

Charles Edward Emery, Ph.D.

Charles Edward Emery was born March 29, 1838, at Aurora, Erie County, N. Y. He is a descendant of the Emery family which first settled permanently at Newbury, Mass., representatives of which spread all over New Hampshire and Vermont, and of which individual members moved to all parts of the United States. Mr. Emery was originally educated at the Canandaigua Academy, N. Y., but he has always been a student, and familiarized himself with various special branches of engineering from time to time. His practical engineering experience commenced while still at school. One of the most farsighted of the engineers on a branch of the Erie R. R., terminating at Canandaigua, took D. K. Clark's work on the locomotive in numbers, which were lent to Mr. Emery, who read them in detail, and explained them to the enginemen in the roundhouse at night. The engines had been run on that division without repair for over two years, and the valves were working badly on account of lost motion. Young Emery recommended that the eccentrics be advanced to restore the lead, and the boy of sixteen, with wedges in hand to try the valves, superintended the operation, while the gray-headed men pinched the engine along the track and re-set the eccentrics as directed. The youth ran one of the locomotives over the road, under the eye of the engineer, to try the effect, before he had strength enough, unaided, to "hook back" for expansion. The results were quite satisfactory. Meanwhile, as a youth, he built his first engine with a jack-knife, gimlet, and three-cornered file. It had wooden connections, wooden flywheel spokes, and a syringe for a cylinder, but the leaden cylinder ports were capped by an iron plate, which, with type-metal valve, were cut accurately to scale and operated by a valve gear, in which the principal motion was given by a link on a stationary center, the lead being obtained independently from the cross head, exactly as in the well-known Waelschaert valve-gear, long after brought out in Germany, and embodied in the heavy pushing locomotives in Belgium, in the Fairlie type of engines built by the Mason Locomotive Works, at Taunton, Mass., and in some steamships by Bryce Douglas. Another model showed the germ of one of the radial valve gears now in use. The boiler used with this engine was improvised from a stove-pipe, wooden heads being nailed in and made tight by boiling bran inside. The fire was necessarily only in contact with the center of the length of the pipe, and the engine was operated on Saturdays for the edification of the children and many of the grown people of the neighborhood. We next find Mr. Emery in the drawing-room of a railroad office, subsequently learning the details of mechanical work in a country shop, where he helped in the foundry, ran the engine, operated iron and woodworking tools, made drawings of machinery or prepared cases for the Patent Office, as circumstances required. Next, at the solicitation of friends, he studied law two years with a view of becoming a patent lawyer, and at odd times busied himself as a land surveyor, and in making land maps and drawings of new buildings. The first shot at Sumter found him on a sick bed, but soon after he was zealously organizing a military company, which was disbanded on account of the proclamation of President Lincoln that no more troops were needed. Soon after Mr. Emery entered the regular United States Navy as assistant engineer, and participated on the United States Steamer '*Richmond*' in the engagement at Fort Pickens, the capture of New Orleans, and the naval attacks at Vicksburg and Port Hudson. His first experience at sea was on a vessel having horizontal screw engines with single puppet valves, operated by enormous rock shafts and lifters and controled by dash-pots—one of the first Sickles-Dickerson adaptations. He was promoted and ordered next to the '*Nipsic*,' the first of the new class of fast gunboats, stationed off Charleston. The engineers had the reputation of carrying all the steam required to beat, and an official trial was finally ordered, with the steam pressure limited to 45 lbs. The vessel easily beat the sloop of war '*Canandaigua*' on a run from off Charleston to Port Royal entrance and back, averaging only about 11 knots, though capable of 12 without restrictions. Some suggestions made by Assistant Engineer Emery as to experimental steam apparatus reached the ears of Engineer-in-Chief B. F. Isherwood, who ordered him to experimental duty at the Novelty Iron Works, N. Y., where a great deal of money was spent for several years, with the effect (at least) to thoroughly educate a few engineers. Mr. Emery resigned from the navy January 1, 1869, and was engaged for a year in making experiments for the Novelty Iron Works in connection with the proposed manufacture of stationary steam engines, and prepared the elaborate circular afterwards published in book form by Vice-President, now Professor, W. T. Trowbridge, entitled "*Condensing and Non-condensing Engines*." He was engaged in the fall of 1869 as the general superintendent of the American Institute Fair, it being at the time arranged that he should go back to the Novelty Works as general superintendent. The directors, however, chose to close the establishment while the books yet showed a profit on marine work, and Mr. Emery entered into business for himself as consulting engineer and patent expert, writing occasionally for scientific papers. He had previously, however, been appointed Consulting Engineer of the United States Coast Survey and United States Revenue Marine, in connection with which he was also made superintendent of some work for the Supervisory Architect of the Treasury Department. Mr. Emery built several new vessels for the United States Coast Survey, and was actively interested in the revival of the compound engine in this country. The first engine built, that for the United States Coast Survey steamer '*Hassler*,' was probably the most economical engine of its size ever constructed; as reports on file show that the vessel, with a displacement of 400 tons, made, with half boiler power a speed of 8 knots, most of the time running a line of soundings, on a consumption of 2½ tons of coal per day. While in the naval service at the Novelty Iron Works, Mr. Emery was employed as consulting engineer by the Hecker Brothers, of this city, to initiate and superintend repairs to the engines and the construction of new boilers, by which the output was increased 50 per cent. in the larger mill. To his credit, be it stated, that another engineer finally worked into the place on the plea that Mr. Emery was so much in favor of compound engines that he was not to be trusted. The Coast Survey appointment terminated when the naval engineers were ordered to the vessels; that of Consulting Engineer United States Revenue Marine is still in force, having continued some 21 years. In this service the machinery for twenty new vessels has been constructed under Mr. Emery's direction, and that of all the others several times repaired and remodeled. In 1874 an opportunity was embraced to place three different types of machinery in three hulls of the same size, one a long stroke, high-pressure, condensing engine, another a short stroke, low-pressure condensing engine, and another a fore and aft compound condensing engine. These vessels, as well as a subsequent one, in which the cylinder of a high-pressure condensing engine was jacketed, were thoroughly tested by a joint Board of Engineers from the Navy and Treasury Departments, Chief Engineer Charles H. Loring representing the former, Mr. Emery the latter. The results were at the time the only reliable ones extant, and the printed reports and an analysis of the same by Mr. Emery were copied in technical literature at home and abroad.

The degree of Doctor of Philosophy was conferred upon Mr. Emery soon after.

Charles E. Emery was one of the judges at the Centennial Exhibition on engines, pumps, and mechanical appliances, and an associate member of the scientific committee on electrical and musical instruments, scientific apparatus, etc.

In 1869, Mr. Emery, while continuing his connection with the Revenue service, became the chief engineer of the New York Steam Company, and finally manager of the company. He designed and built the entire plant, providing (as most know) four stories of boilers, aggregating 16,000 h.p. at the Cortlandt Street Station, using wrought-iron pipes of the largest size it was then possible to obtain (some 15″, and even 16″ in diameter), designing special expansion joints and other details, and making the work a complete mechanical success. Steam was supplied through service pipes, 8″ and 10″ in diameter, to buildings like the Produce Exchange, the Mutual Life Building, and finally, the New York Court House and Post-office at distances of ½ to ¾ miles from the station. The work operated very satisfactorily, while a rival company, on the east side of the city, whose pipes were continually exploding, was obliged to give up business. At a later period leaks developed on the lines of the New York Steam Company, but the important ones can be traced to interference with the workmen by a superior officer of the company, who, notwithstanding protestations, was endeavoring to cheapen matters as the work progressed. The work put in originally, before so much was being done that it could not receive the personal inspection of the engineer, has given no trouble to the present day.

The interference with travel incident to putting in the enormous steam plant in the first place, the failure of the rival company, and the neglect of the New York Steam Company to promptly put its work in order where it had been slighted, have given it a bad name, but Mr. Emery thinks that the enterprise itself has come to stay. Leaks are annoying and must be stopped, but they do not affect the strength of the pipes, and the original steam pressure of 80 lbs. is still carried. Steam supply from the streets has enabled older buildings down-town to put in all modern improvements; basement offices previously overheated by boilers have become desirable property, and lofts formerly of mere nominal value are now in demand for manufacturing purposes. The operations of the company have, therefore, been of the greatest value to property interests in the lower part of the city, and the smaller station up-town is a great convenience to residents in that vicinity.

Mr. Emery resigned from all participation in the affairs of the Steam Company in October, 1887, up to which time there had been expended on the work nearly $2,000,000, and has since been doing a general engineering business and preparing for the introduction of a novel enterprise, the object of which cannot be made public at present.

Mr. Emery has been consulting engineer of the terminal facilities of the New York and Brooklyn Bridge, and several principal plants of the Edison Electric Lighting Company, and has been connected with the building of steam yachts, a subway company, and other prominent enterprises. He is a member of the *American Society Civil Engineers*, the *American Society Mechanical Engineers*, the *American Institute Mining Engineers*, the *American Association for the Advancement of Science*, and of the (British) *Institution of Civil Engineers*, receiving from the latter a "Watt Medal" and a "Telford Premium" for an approved paper. He lectures at Cornell University and on the United States Revenue Marine Schoolship, and is chairman of the Engineer Examining Boards of the United States Revenue Marine.

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RATE OF COMBUSTION IN LOCOMOTIVES.

Experiments were made some time ago on the 17-mile grade of the Baltimore & Ohio Railroad by George B. Hazlehurst, now General Superintendent of Motive Power of that line, to show the maximum quantities of coal burned per square foot per hour in the grates of locomotives. The grade referred to begins at Piedmont, and has an ascent of about 117 ft. per mile for 17 miles. This grade is often combined with sharp curves, so that it is a continuous hard pull for the whole distance, and it gives an excellent opportunity of making a test of the quantity of fuel which can be burned in locomotive grates. One experiment was made with a ten-wheeled engine and a train weighing 352,000 lbs. The running time was just 60 minutes, and the total coal consumed was 3,391 lbs.=148.1 lbs. per square foot of grate per hour. A second test was made with the same engine on September 20, 1889. Total weight of train, 380,000 lbs.; running time, 67 minutes; coal consumed, 3,809 lbs.; consumption per square foot of grate per hour, 133.2 lbs. In both of these tests there was a dry rail and an average steam pressure of 143¾ lbs. The dimensions of the engine were as follows: weight in working order, 114,500 lbs.; on driving-wheels, 91,000 lbs.; cylinders, 19×24 in.; diameter of driving wheels, 60 in.; total heating surface, 1,899 sq. ft.; size of grate, 33×100 in.=22.9 sq. ft.; diameter of tubes, 2 in. Another test, still more remarkable, was made with an American type of engine. The weight of the train was 378,900 lbs.; coal consumed, 5,316 lbs.; coal consumed per square foot of grate per hour, 193.7 lbs.; running time, 59 minutes. While the last experiment was made the rail was dry; the average steam pressure was 148.1 lbs.; the dimensions of this engine were: total weight in working order, 107,700 lbs.; weight on driving-wheels, 73,400 lbs.; cylinders, 20×24 in.; diameter of driving-wheels, 66 in.; total heating surface, 1,511 sq. ft.; size of grate, 34×120 in.=28.3 sq. ft. The experiments were made by running a distance of about 17 miles. There can be no doubt of the accuracy of the tests, and they show that the maximum rate of combustion in locomotive fire-boxes is considerably greater than is ordinarily supposed. Rankine gives this rate, "with draught produced by a blast-pipe or fan," at 40 to 120 lbs. per square foot per hour. The latter amount has generally been accepted as the maximum quantity burned. Probably 200 lbs. of coal are often burned per square foot per hour in locomotives in this country.—*Engineering Journal.*

Foreign and Domestic Trade Literature.

ELECTRIC MOTORS COMPARED TO LOCOMOTIVES.

At the last convention of the American Society of Civil Engineers Mr. Lincoln Moss read a paper giving comparative tests of an electric motor and of a steam locomotive on the Manhattan Elevated Railway, New York. A great deal of speculation has been indulged in about the possibility of operating the elevated railroads with electric motors rather than with steam locomotives, and the author of the paper, who is in the engineering department of the company, was detailed by Col. Hain, general manager, to ascertain by careful tests the relative economical value of electricity and steam locomotives.

The trials were made on the Ninth Avenue line, with the newest style of passenger cars, which weigh 29,500 pounds each. Two cars were used first, then three, and finally four. Electricity was generated by a first-class plant, located conveniently to the section where the tests were made, and the power developed by the engine while at work varied from 43 to 400 h.p. The expenditure of 43 h.p. was required when the train was standing at stations, that amount of energy having been consumed in friction, local currents, current waste, resistance, and leakage.

Four generating dynamos, nominally 50 h.p. each, were used. They could be worked in parallel or in series by means of a switch. The current was conveyed from the dynamos to the railway structure conductors by two insulated copper cables strung on poles. At the structure the cables were divided to connect with the three positive conductors on the east, center, and west tracks.

The electric motor weighed about ten tons and was carried on two pairs of driving wheels 48 inches diameter, that were coupled together, and had a wheel base of six feet. The driving dynamo was carried on a supplementary shaft set above the back driving axle, to which it transmitted the power by means of gearing. The average power generated by the stationary engine was 176.8 h.p., while the amount converted into useful work at the track was only 26.7. The highest horse-power developed by the motor was 52 h.p., and the lowest 9 h.p. The average efficiency of this means of transmitting power was found to be .151, and the average loss 48.9 per cent.

The greatest power of the engine was exerted when the train was starting, and the motor showed the least efficiency at that time, proving that there is nothing in the oft-repeated theory that an electric motor would start a train with less loss than a steam locomotive, which has to use the steam throughout the full stroke in starting. In working to start the train on a hard pull the steam engine exerted 395 horse-power, and only 7.6 of this was utilized by the motor, so that 387.4 horse-power of energy was lost in transmission.

The action of an electric motor, says the author of the paper, bears some resemblance to that of a steam locomotive. In the latter, in starting, the distribution of the steam is the most wasteful, and the average pressure on the pistons is the greatest when "notched up" so as to expand the steam more economically; the economy is very much improved, and the average pressure falls comparatively low, but although low, it is applied so much more rapidly that a greater horse-power is developed. So in an electric locomotive the electrical pressure is greatest when starting because of the "resistance" introduced, and the current used is greatest, owing to the absence of counter-electro-motive force; but as the speed increases and the resistance is cut out and the counter current increases, the electrical pressure becomes less, and also the current used, for it is evident that if the speed of the motor was increased enough, the new or counter current generated by the driven motor acting as a generator, would equal the current derived from the generating dynamo and no work will be done by the motor; so that when the motor is working rapidly and the impulses are of low-pressure and quantity, the efficiency is the greatest, although it seems like a strange kind of efficiency which depends upon the development of an opposing force.

A great many trials were made under varying conditions, and one interesting fact among others developed is, that the economy with light trains at higher speeds becomes poorer, apparently contrary to the general principle that the economy of stationary electric motors increases with the speed and the reduction of the load, and many believed that a better showing would be made with such tests. It is true that tests made with light trains of two or three empty cars run at a high speed, but making no stops, showed much better results; but such conditions are not at all practical in operating elevated or other railways. It is true that a lightly loaded stationary motor, running at a nearly constant high rate of speed, will show maximum economy, but in the case before us, where the motor was changing its speed continually, and stopping and starting, the rule will not apply.

It was found that the electric motor had not power sufficient to handle a train under ordinary working conditions, and it was determined, as a basis of comparison, to use a small locomotive to pull the same train over the same track at the same speed attained by the motor. The engine selected had cylinders 11×14 inches and two pairs of drivers coupled 36¾ inches diameter. Very careful tests were made with this engine by the same men who had tested the electric motor. The efficiency of the locomotive was calculated to be .85, as compared with .151 for electricity. By comparing the coal used by the stationary engine and the other expenses of running the plant, with the coal used and other expenses incurred in operating the locomotive, it was calculated that the power from electricity cost 2.38 times that supplied by the locomotive to run the train at an average speed of 9.4 miles per hour. To supply the increased power for running the trains at 15 miles an hour it was estimated that electricity would cost 4.7 times that incurred by the locomotive.

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A VISIT TO HIRN'S ENGINES AT LOGELBACH.

Much has lately been written about M. Hirn, the great scientific worker, whose death was greatly deplored a few months ago. His invaluable labors in the field of mechanical research, and the theories he succeeded in establishing as the result of innumerable experiments, have become known and appreciated in England, and it is no longer necessary to vindicate his place among the foremost practical scientists this century has produced. An account of a visit to his former home may therefore be of interest.

Gustav Adolph Hirn was born at Logelbach, near Colmar, in 1815, and in this unpretending little village he lived till within ten years of his death. Here were carried out all those important experiments which made his name so well known, and here the little knot of pupils, friends, and helpers, gathered round him, who are known on the Continent as the Alsatian school of engineers.

The mill employs about 1,000 hands. The original building, still intact, is nearly 100 years old, but auxiliary workshops have been added as the necessity arose, and bordered the road for a distance of nearly a quarter of a mile. On the opposite side of the road are workmen's cottages, gardens, orchards, and conspicuous among them the house where Hirn was born, where he settled after his marriage in 1860, and spent the next twenty years in ardent and unremitting labor. Though outwardly uneventful, these twenty years cover the most important period of his life.

Originally M. Hirn had under his superintendence a single-cylinder vertical non-jacketed steam engine, and a double-cylinder engine, also vertical, which could be worked with or without a steam jacket. The single-cylinder engine has been running uninterruptedly for forty years, and is still daily in full work, but both cylinder and beam were renewed by M. Hirn. It is about 100 i.h.p.; the diameter of the cylinder is 23¾ in. and length of stroke 67 in. M. Hirn's arrangement for superheating the steam, one of the first put to test and practically applied, is still always in use, and is considered to give a greater economy of feed water than the steam jacket. The amount of superheating is about 140° Fahr. The superheating apparatus consists of a series of pipes, and is invisible, as it is placed toward the end of the boiler, where the hot gases play constantly over its surface. This method involves no additional expenditure of fuel or of labor. The mere fact that the superheating arrangement has been in constant operation for so many years, without more detriment to the valves, gear, etc., than is incidental to any engine when at work, proves that the system is of real practical advantage, and deserves more attention than it has hitherto received. In 1880 the mill passed into other hands. M. Hirn removed to Colmar, and care was no longer taken to work the engines on the lines he had laid down. Yet the practical value of superheating had already been so fully proved by repeated trials and tests, that the method he had adopted was continued, and is still employed.

The fate of the second engine at Logelbach was more checkered. Originally a double-cylinder Woolf beam engine, it has been subjected to many elaborate experiments. M. Hirn abolished the old system of valves he found in use, and replaced it by another arrangement devised by himself. After numerous trials, fully and carefully described in his works, he further decided in favor of the single-cylinder engine type, and removed the second cylinder. Thus the chief alteration he effected was the substitution of a single-cylinder, made with two separate steam and two separate exhaust valves, for the compound engine. These valves were shut and opened by cams, and so arranged that the steam valves were worked automatically from the governor. For a long time M. Hirn used a steam jacket with this engine as well as superheating, and his most famous experiments were made upon it. It was this engine which broke down in 1878. Convinced at last that a steam jacket was superfluous where superheating was employed, Hirn finally abolished the jacket. As he left it, so the engine still stands, with an arrangement for superheating similar to that already described, but without a jacket. The dimensions are about the same as those of the other engine. It is now used only when the water supply of the mill is insufficient, but it is complete in all its parts, and runs for several months every year.

Outside the engine house is still visible part of the arrangement devised by M. Hirn for measuring the quantity of condensing water from the air-pump by means of a circular hole in a tank. At the top of the building is the instrument he called a pandynamometer, with which he not only measured the deflection of the beam, but took a diagram and compared it carefully with the indicator diagram, while all over the engine numberless cocks and pipes bear witness to the minute and unceasing care with which he studied and endeavored to modify its mode of action.

It may be well, in conclusion, to summarize the memorable results obtained with these engines. About the year 1855 Hirn had at work a single cylinder non-jacketed engine, with 65 lbs. boiler pressure, the amount of superheating being from 130° to 150° Fahr. The piston speed was 340 ft. per minute. With this comparatively slow running beam engine, Hirn obtained the following very economical results: the quantity of feed water per indicated horse-power per hour was 15¾ lbs., and the gain in economy obtained by superheating the steam 23 per cent. These may be considered as remarkable figures for the time. —*Industries.*

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THE PROGRESS OF ELECTRICAL TRACTION.[*]

* * * * Given an electric motor and car, how can they be combined? Where should the motor be put, and how should it be connected with the driving wheels? Almost every conceivable spot in and about a car had been tried as a place for the motor—on the platform, in the car, on top of the car, and under the car, in almost any position that could be named. Not until the present method of swinging the motor from the car axle, so that the armature would be at all times equi-distant from it, was devised, were thoroughly practical results secured. But the great difficulty in the way of using the electric motor is one which at first sight does not suggest itself—the high speed at which the motor ordinarily runs. It has been up to the present quite of the question to build a light and efficient motor in which the armature should revolve at a low speed; I mean by that 100 revolutions per minute, or something of the kind. With the ordinary motors running from 800 to 1200 revolutions per minute, it is obviously absolutely necessary to reduce the speed by some kind of gearing in applying it to a car-axle; for if this were not done the speed of the car would be preposterously great. Within the last ten years almost every known mechanical means for reducing speed has been applied to the problem; belts, chains, ropes, worm-gearing, and every description of toothed gear, has been pressed into service, but one after another has been discarded as impracticable, until at the present nearly all electric cars are operated by plain toothed gearing. In the existence of this lies one of the difficulties that must be overcome in the future.

Then, too, it was a matter of no little experimenting to find some way of conveying the electric current to the moving car. Cars running on an overhead wire and dragged by wires from the car were and are still in use. Copper tubes slotted beneath were employed, in which the car dragged along a wire brush much after the similitude of a gun cleaner. Then came every description of underrunning trolley, from a wire broom that scraped and ground along the conductor to the present smooth-running little wheel.

Then another snag was encountered. After the electric current is led to the car, how can it best be conveyed to the moving parts of the motor? The ordinary brushes, such as we see on the commutators of dynamos answer the purpose admirably, except for one inconvenient fact—that it is necessary to run the armature of a motor in more than one direction, as when the car is on the return trip, and the copper brushes that worked admirably well when the armature revolved with them, raised a blazing protest when the armature revolved against them. If I were asked what is the most important minor improvement in electric traction, I should say unhesitatingly that it is the introduction of the carbon brush that rests quietly on the surface of contact, and is quite indifferent as to the direction of rotation of the commutator beneath it. Aside from these fundamental difficulties, minor ones were met at every point of the construction of an electric railroad. The trolley wire is necessarily under high tension, and only after elaborate experiments was the hard bronze wire now used found and adopted. Then this very tension brings a severe strain on the supporting poles, and all sorts of ingenious devices had to be invented to sustain and equalize it. The electric car of 1890 is a machine that is marvelously successful, and in view of what is being done in every succeeding week, it is not too much to say that the horse's occupation in street car work is practically gone.

Now, let us look for a little at what can be done, and glance at the probable lines of improvement. To-day the grinding gear wheels underneath the car constitute the most serious mechanical difficulty in electric railroading, and it should be the object of inventors to dispense with them, if possible. They rattle and squeak, teeth break, bearings get hot, and there is no man practically acquainted with their manifold failings but heartily wishes them out of the way. It is possible, although it has not been successfully done, to build a motor of which the armature shall be directly upon the car-axle, and that yet will operate with a fair degree of economy. This done and we should have a system of electric traction almost ideal in its simplicity; a single rotating armature grasped and centered between field magnets surrounding the axle, the current supplied to it from a movable contact, a switch to control it. That is all. And few people have any adequate idea of the mine of power these same grinding cogwheels waste.

A question that is often asked is: Why is it necessary to put two 15 h.p. motors under a car of the same size that was previously drawn by a couple of mules? The question is a very pertinent one, though the answer is somewhat complicated. In the first place, what do we mean by a horse-power? That is well enough known to most of you. We mean a power that is equivalent to 33,000 foot-pounds per minute; in other words, a power that will lift 33,000 pounds one foot high in one minute, or one pound 33,000 feet high in a minute, or a similar combination of pounds and feet. Horse-power at best is a barbarous unit. The particular quantity I have mentioned was derived from ancient experiments on the tractive ability of horses. One important fact should, however, be borne in mind—that very few horses are equal to an output of an alleged horse-power for any length of time, but, nevertheless, can do work of considerably greater amount for a very short time: just as a man, in a sudden moment of violent exertion, can accomplish feats which he would be totally unable to perform continuously. So the two mules on the street car we have mentioned exert considerably more than two horse-power (or two mule-power) at the moment, for instance, of starting the car, but they could not exert that power continuously in dragging it. We are in the habit of estimating the power of motors in horse-power, counting it not directly but in the unit of power known as the watt, and usually used in computing electrical work. The watts output of any given machine equals the product of the amperes by the volts. It is the unit of work, because in our modern system of electrical units the volt and the ampere are based on definite units of force, so that we can say with perfect certainty that one volt-ampere is equivalent to a certain amount of power, inasmuch as we have chosen the volts and amperes with that purpose in view. As a matter of fact, 746 watts make 1 h.p., so that we can readily compute the power of a given motor. In addition to the other failings of the horse-power as a practical unit, the same quantity is not meant by a horse-power in different countries. The French *cheval a vapeur*, for instance, is 735 instead of 746, so it has been suggested—and it is to be hoped the suggestion will be carried out in future practice—that work with power of all kinds should be estimated not in horse-power, but in kilowatts; that is, in units of 1,000 watts—a little over the present horse-power, and convenient in every way for computation. But this is a digression. Why is it that two 15 h.p. motors are necessary? In the first place, it has been found convenient to run electrical cars at a great deal higher speed than horse cars, consequently to employ more power. In the second place, electrical roads operate with very heavy loads on grades that are tremendously severe, as steep as 1 foot in 10. All this requires still more power, but does not explain fully the discrepancy between these 30 h.p. motors and the aforesaid two mules. When we come to examine the power which is required to operate electric cars, taking the average of all day long, we find that the difference is not by any means so great. Somewhere from 3 to 6 h.p. is about the amount. A sudden spurt up a sharp grade will perhaps require half a dozen times this amount; and this is not disadvantageous, for a motor, like a mule, can, we see, pull very hard when it becomes necessary. But let us turn a little to experiments made with the view of answering the question I have raised. Most of our present electric cars have two motors, each with its appropriate set of gears, and it is an unfortunate fact that these two do not always pull together in the harmony that might be desired. There is a constant tendency for one or the other of them to do more than its share of the work, and, aside from this, the two sets of gears consume an outrageous amount of power, which, it should be remembered, does not go into any useful work, but simply tends to heat and wear out the running parts. Experiments tried last winter in Colorado show the facts of the case very beautifully. A 5-ton car, operated with both motors, at an approximate speed of 12 miles per hour, required something like 6 h.p.; using only one motor, the horse-power required was reduced to 5 for about the same speed; and finally, removing the pinion from one of the armatures, so that the car was operated by one motor and only one set of gears, the power was reduced to something like 3½, which, considering the load and the speed, is not at all too high. A pull of something like 20 pounds per ton is required on ordinary tracks; that is, the motors in this case were pulling 100 lbs., at the rate of 12 miles per hour, which, reduced to foot-pounds and then to horse-power, becomes about 3, which gives the motor that actually exerted about 3½ horse-power, a very reasonable degree of efficiency. So the cost would not be at all bad with one motor either on the axle or simply geared. It is clear that there is a disadvantage in the use of two motors, except in so far as it is convenient to drive both axles for ease of ascending grades, and it is no less evident that a considerable power can easily be lost in gearings.

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[*] Paper, by Dr. Louis Bell, read before the Scranton Science Club.

We should remember that certain losses in the motor cannot be avoided. In the first place, the current that drives the machine heats it by an amount we can definitely determine. In the second place, the revolution of the armature sets up little electrical eddy currents in various parts of the machine precisely after the manner of a common dynamo. In the third place, still other power is used up in producing a class of magnetic reactions in the iron core of the armature known as hysteresis. These necessary losses may easily amount to a horse-power in an ordinary street car. So we may hope in the near future to have a system of motor cars in which considerably less power will be required than at present, and this by the simple though somewhat difficult process of simplifying the running gear.

But the possibilities of electric traction are by no means exhausted in its application to street cars. I do not hesitate to say—and I say it deliberately—that to operate an ordinary railroad train by an electric locomotive is a far simpler problem electrically and mechanically than the operation of the street cars here on the streets. The slow speed necessary for street cars is, as I have already said, a disadvantage in that it compels us to gear down the motor. In running at railway speed no such difficulty is encountered, for the four or five hundred revolutions per minute made by the drivers of an express locomotive is just about the proper speed at which an electric motor of corresponding power could be advantageously run. We should then be enabled to dispense entirely with the obnoxious gearing, and to put directly upon the axle of the driving wheels an armature big enough and powerful enough to generate the required speed. Nor is there any practical difficulty in building motors big enough to do the work. There are plenty of 100 h.p. dynamos now running, and the increase of size sufficient to duplicate the power of a locomotive is the simplest sort of mechanical operation. I do not think there is a prominent electrical company to-day that would hesitate to take an order for a 500 h.p. machine, and guarantee its performance. I certainly know of several that would be glad of the chance, and would accomplish the task successfully.

There is no sort of difficulty in conveying the current to one of these big motors moving at railway speeds, for it has been established by experiment that the method of running contacts such as is in general use will work admirably up to the speed of 130 miles per hour, at which speed an electric car of respectable dimensions has been actually operated. The question, then, of using the electric motor for railway work is not a question of mechanical or electrical difficulties, but of economy. It is worth while noticing that in an electric locomotive the big machines can be given an amount of care quite impossible on our street cars, for the good reason that while the street car motor is exposed to the wet and dust and dirt to an enormous extent, in an electric locomotive the whole can be boxed up inside of a clean car, and given practically as careful attention by the engineer as is now possible in a dynamo operated in a central station.

Now as to the question of economy. The steam locomotive, in its present stage of development, is a remarkably successful machine. Nevertheless, it does consume more coal proportionately than is used, for instance, in the engines of a big steamship like the '*Umbria*' or the '*City of Paris*.' It burns, in fact, between two and three times as much coal per horse-power of output. This is not due to any radical defects in the locomotive, which, all things considered, is a good and economical machine; but arises from the fact that the huge engines of the transatlantic liners are condensing engines, nearly always triple expansion, while the locomotive is a simple engine of a class that has generally been abandoned for steamship use. The principal advantage that we would gain by using large electric motors supplied from a central station, instead of the present steam locomotives, would be a much more economical use of coal. It is safe to say that the consumption of fuel for a given number of horse-power produced by big engines in an electric station could be reduced to less than half what is now used to supply a similar amount of power in the locomotive. To offset this advantage there is the necessary loss of power in conveying the current generated to the running motor. If the length of line to be operated from a single station is great, this loss may be considerable ; but it is unquestionably smaller than the gain to be made in the way I have suggested. Besides this, the electric locomotive does not have to drag around its supply of coal and water.

There is, too, the magnificent possibility of economy in the use of water power. Very many of our railroad lines follow the course of some river, winding in and out along a valley ; frequently there would be an abundant supply of water power near at hand, and under such circumstances the cost of operation for an electric road would become enormously less than for the same line operated by steam. Of course, this is under favorable circumstances, and therefore we should lay not too much stress upon it; but I think it is clear to anyone who is familiar with the operation of big condensing engines that their advantage in economy over a locomotive is so great as to make it worth while to distribute the power from them even at a considerable loss. The amount of copper line wire necessary for such distribution is not at all unreasonably great ; no greater, in fact, than the amount now used in trunk lines for long-distance telephony ; and there is every reason to believe that, taking into consideration all these things, an ordinary railroad could be operated by electricity at a cost less, or at least no greater, than is now incurred.

As the speed to be attained rises, electric power gains over its competitor ; for a high speed locomotive must cary an enormous amount of of coal and have a boiler of prodigious capacity ; while, inasmuch as we do not have to move the fuel or boilers of a central station, their size is a matter of indifference. The speeds that are reached now with locomotives can be duplicated with motors without difficulty. I believe the present record for locomotive speed is 87 miles per hour, made this year on the Philadelphia and Reading road, while last year, as I just mentioned, an electric car, small to be sure, but at the same time running under some disadvantages as regards track, attained a speed of two miles per minute. In fact, economy aside, I do not see that we can set any limit to the running speed of a motor, except that imposed by adhesion, the strength of the steel in the flying drivers to withstand the centrifugal force, and the conditions necessarily imposed on the strength and smoothness of the track.

HOW WOOD IS CHANGED TO STONE.

One of the most interesting fossil formations is silicified wood, known as wood-agate or wood-opal, found in great abundance in our Western States and Territories. Of its formation Professor Joseph Le Conte, in "*Elements of Geology*," says:

"In a good specimen of petrified wood, not only the external form of the trunk, not only the general structure of the stem—pith, wood, and bark—the radiating silver grain and the concentric rings of growth are discernible, but even the microscopic cellular structure of the wood and the exquisite sculpturing of the cell-walls themselves are perfectly preserved, so that the kind of wood may often be determined by the microscope with the utmost certainty, yet not one particle of the organic matter of the wood remains. It has been entirely replaced by mineral matter, usually some form of silica." Professor James D. Dana offers the following explanation of the phenomenon : The wood or often trunks of trees and sometimes standing forests, which have been petrified in the Rocky Mountain region, have in general been buried under volcanic debris, which constitute beds of great extent. This volcanic material, called tufa, undergoes partial alteration through the action of the waters or moisture it may contain, or that may filtrate through it. In this alteration or partial decomposition much silica is set free and makes the water or moisture silicious. The silicious solution then made penetrates the wood that is buried in the tufa. Very slowly the silica is deposited in all the cells of the wood, and as the wood decomposes, silica takes the place of the particles of the fibers until finally the wood becomes wholly silica or quartz.

Red and yellow colored matter is derived from the oxide of iron in the sandstone, which is red, and the black may be due to partial carbonization or to oxide of manganese. The bark in nearly every case has been decayed before silification, and even part of the other layers of the trees is often gone; but the difference between the oxidation on the surface and inside is that the surface to the depth of ½ in. is so altered and changed that it has the appearance of bark and it is generally supposed to be such. Among the American wonders is the silicified forest, known as Chalcedony Park, in Arizona; the most remarkable feature of the park is a natural bridge formed by a tree of agatized wood spanning a canon 45 ft. in width. In addition to the span, fully 50 ft. of the tree rests on one side, making it visible for about 100 ft. Both ends are embedded in sandstone. The average girth is 3½ ft. Although beautiful to the naked eye, it is only by the application of a micro scope that the greatest charms are found. There are several districts where this agate wood is found. The combinations of color, close texture, and remarkable polish, eminently suit it for tiling floors, mantels, table tops, clock cases, etc. The lustre of its finish cannot be marred by metal or acid.

LATEST LEGAL DECISIONS ON TRADE.

REPORTED FOR THE ENGINEER.

[WE shall until further notice publish the latest decisions in courts of last resort upon topics of general interest to our readers. From these decisions they will be able to judge in a measure of their own chances in similar cases.]

Construction of Petition for Patent.—A claim for a mill constructed of conical shape with an eccentric motion as described in such claim, is not a broad claim covering any mill having such shape and motion, irrespective of its other features of construction and operation. Words of limitation in claims are not to be disregarded, and claims cannot be broadened by eliminating or disregarding such words. The improvement of one of the elements in a combination of all old parts, which does not affect the operation of such combination, does not make a new one. Such changes relate to the part improved and not to the larger combination.—*Gates Iron Works* v. *Fraser, United States Circuit Court, Northern District of Illinois,* 42 *Fed. Rep* 49.

Answers in Application for Accident Insurance.—When one answers all the questions asked him on applying for a policy of accident insurance, and after he has signed such application, the agent inserts an untrue statement as to the income of the applicant, the company is liable under the policy, though the assured was practically insolvent when the application was made.—*Sawyer* v. *Equitable Accident Ins. Co. of Cincinnati, United States Circuit Court, Eastern District of Wisconsin,* 42 *Fed. Rep.* 30.

Collision—Crossing Steamers—Stopping instead of Holding Course.—The '*Britannia*' and the '*Beaconsfield*' exchanged signals to pass port to port. When about a half mile apart, the former touched bottom, and, to avoid grounding, went straight ahead at full speed for about half a minute, and passed some 600 feet of deep water without turning into it. Her swing to starboard was then retarded by the ebb tide and west wind, though her helm was put hard-a-port, and for a brief space she made a slight swing to the westward. The '*Beaconsfield*,' being retarded by tide and wind, was going much slower than the '*Britannia*' at the time, not indicating that she was porting. The '*Beaconsfield*' blew a single whistle, and, hearing no answer, reversed, the danger of collision continuing. Shortly after she reversed, the '*Britannia*' commenced to swing to starboard, and apparently they would have collided had the '*Beaconsfield*' continued. Her pilot testified that there was a reef of rocks which made it dangerous for her to continue in her course. The '*Beaconsfield*' was without fault, and the '*Britannia*' was liable for the loss of her and her cargo.—*The 'Britannia,' United States Circuit Court, Southern District of New York,* 42 *Fed. Rep.* 67.

Collision of Steamers.—Two vessels desiring to cross each other's path signaled the way in which they would do it. In doing so one stopped and reversed its engines, the other reversed and signaled for the former to go on. A collision occurred, the former being injured. Her owners could not recover, she being in fault.—*St. Johns, Circuit Court of the United States, Southern District of New York,* 42 *Fed. Rep.* 75.

Construction of "Heirs" in Benefit Certificate.—Under the Arkansas statute, the word "heirs" in a benefit certificate means those designated by the statute of distribution of personal property, which excludes the wife, except in the event that he leave none of his own kindred surviving him. Where a society pays money under a benefit certificate into court to await the decision of who it belongs to, the provision in the certificate that the beneficiaries shall be limited to the members of the assured's own family, or those dependent upon him, will avail to change the rule of the statute.—*Johnson* v. *Supreme Lodge of Knights of Honor, Supreme Court of Arkansas,* 13 *S. W. Rep.* 794.

Collision of Steam Vessels.—Two steamers were proceeding by night up East River; they were not on parallel courses; in crossing each other's path a mistake in understanding signals caused a collision. The case turned on the signals, and having been once decided, will not be reversed.—*The 'Sea Gull,' United States District Court of New York,* 42 *Fed. Rep.* 190.

Evidence of Compomise—Excessive Verdict.—A conversation of an insurance company's adjuster, who adjusted the loss, as to compromise of claim, is inadmissible, unless it is clearly shown that it had been communicated to plaintiff. A verdict for $700 for a house that had been standing for fifteen years and was valued by disinterested parties at $734, is excessive.—*Guinn* v. *Phoenix Insurance Co., Supreme Court of Iowa,* 45 . *N. W. Rep.* 880.

Liability for Injury while Loading Vessel.—A longshoreman was engaged helping to load a vessel with flour. He was stationed on the lower deck when it was quite dark, and could not see that the part of the lower deck was not planked over. In lowering the flour he was struck by a load or draft of flour and knocked into the hold, resulting in his death. His representatives are entitled to recover, as it is the duty of the employer to provide for the employee a safe and proper place in which to prosecute his work, and if this duty be entrusted to others and they fail to discharge it, and in consequence an injury results to another person in the service of the employer, the employer will be liable or neglect of his vice-principal.—*Hogan* v. *Smith, Supreme Court of New York,* 9 *N. Y., Supp.* 881.

HEAT ENERGY.

IT has been established that the condition of a body familiarly known as "hot" arises from a vibration of its particles, which affects our sense of touch in a manner analogous to that in which sound affects the ear. It is necessary to distinguish carefully between the vibration of a *body* (which has nothing to do with heat) and the vibration of the *particles* of which that body consists (which *is* heat). Thus, when a bell is struck by a hammer there are several kinds of vibration set up simultaneously. The bell may swing slowly from side to side, which is a vibration of the bell as a whole. Then there would be the vibration of the sides of the bell inwards and outwards producing a musical note, the rate of vibration varying with the pitch of the note produced. But if we continued hammering away at the bell until it became sensibly heated by the successive blows, we should induce a third kind of vibration, of a more subtle character than either of the others, viz., the physical cause of the sensation known as heat. All bodies possess this kind of vibration to some extent, for, in order to deprive a body of all heat, it would require cooling down to the absolute zero of temperature, a point 490 of Fahrenheit's degrees below the freezing point of water. At such a temperature a body would be called "cold." No other meaning can be attached to the term cold than the loss or absence of heat. There is a well-known experiment in which the same body is made to feel first warm and then cold, simply by altering the temperature of the hand which touches it, the body remaining at the same temperature all the time. We may infer that a higher temperature is the effect of a more rapid vibration of the particles, accompanied perhaps by a greater "amplitude" or movement of the same. And as there must be energy where there is motion, we may arrive at the conception of heat not only as a mode of "motion" but as a measurable quantity of energy.

Every one is familiar with the fact that friction develops heat, that hammering a piece of metal makes it hot, and that air is heated by compression. In each of these instances there is an expenditure of mechanical energy. But the expenditure of mechanical energy was not thought to be the *equivalent* of the heat developed before Count Rumford was led to this discovery by observing the unlimited amount of heat which is developed during the boring of cannon. The exact amount of heat which is developed by the expenditure of a given amount of work was determined for the first time by the late Dr. Joule. It takes 772 foot pounds of work to heat a pound of water one degree in temperature by mechanical means. This is sometimes expressed by saying that if a pound weight fell from a height of 772 feet into a pound of water it would raise the temperature of the water one degree Fahrenheit. The above is a very convenient way of remembering the meaning of the "mechanical equivalent of heat," but it is needless to remark that the talented Dr. Joule died without having tried this particular experiment himself.

The facility with which mechanical energy is converted into heat is very noticeable in many operations; indeed the difficulty is generally how to prevent such transformation. If any method could be devised of working metal by which no heat was produced during the operation, there would be a saving of useful energy to that extent, which now goes to produce useless heat. In one sense, however, the heat is *not* useless, for in many cases it may be a convenient guide as to the good working of a tool. In the running of machinery also, if it were not for the work lost in friction (which is generally deplored), developing heat in exact proportion to the loss of work, there would be no warning of danger until bearings were cut to prices. The amount of work lost by the heating of bearings is considerable. Every pound of iron heated one degree in temperature represents a loss of about 80 foot pounds of work. Hence, if 1,000 lbs. of metal become heated 100 degrees, the lost work amounts to 8 million foot pounds, or the work of 242 h.p. for one minute. It would probably tend to economy if a thermometer could be devised acting upon the thermo-pile principle, by which the temperature of important bearings could be read off at any instant upon a dial after the fashion of a pressure gauge. It is, moreover, a reproach to science that for the thousands of times an engineer must ascertain the temperature of a troublesome bearing, he is left to rely upon the thermometer which nature has provided, namely, his naked hand, or as many fingers thereof as a few years of such a practice may have left him blessed with.—*A. N. Somerscales.*

◆

A CRITIC pokes a little fun at a Japanese circulating library, which issues a circular in English that is certainly a little off.

By some process the proprietors of the library have decided the time necessary for reading books of various classes. This is set forth in part as follows:

> "All Novel and thin Book is five days.
>
> "All Sciencial Book is almost ten days.
>
> "English Language Book which is not many pages is limited ten days but large Book is fifteen days."

This might be worse, and if the critic undertook to translate English into Japanese he would probably catch on the center himself.

◆

SOME one has kindly sent us a circular of a "*Patent Mid Ship, Floating Screw Flange Propeller,*" which is to upset everything (except the ship). It is a waste of time to review such things.

◆

ONE firm in this country makes 2,000 watches daily.

TRADE NOTES.

William Sellers & Co., of Philadelphia, have the contract for building eight lathes for making 16-inch guns for the Washington Navy Yard. The price is $416,460, and they are to be built from Seller's designs.

⁂

The cost of firing a 110-ton gun is, in round numbers, $832. But this is not all. The 110-ton gun can be fired but 95 times, and after that requires repairs. The cost of the piece being $82,400, it is necessary to estimate the cost of wear at about $868 for each shot, thus raising the cost of each charge to $1,700.

And it is very uncertain whether you can hit anybody with it, even at the very high price.

⁂

The Burns Oil Conduit and Burner Company, recently incorporated under the laws of Vermont, has just been organized at Bennington. Mr. Burns was elected the engineer of the company. The capital stock is $500,000. The object of the company is the manufacturing, buying and selling of devices connected with conducting and burning oils, liquids or gas for fuel or illumination, etc. The company claims that it owns an invention whereby petroleum may be safely and practically used for fuel. The essential part of the scheme is the forcing of water through petroleum.

⁂

The Sault Ste. Marie canal lock was disabled through the breaking down of one of the discharge valves. Eighty-nine hours of a cessation of Lake Superior commerce resulted in a jam of upwards of 200 vessels. Placing their mean value at $150,000, it would show a valuation of thirty million of dollars worth of property paralyzed through the break down of a single valve. This accident should convince the Government of the necessity of passing the Sault Canal appropriation bill immediately. The loss to vessel owners and other interested parties in this case alone will be large enough to complete the new lock.—*Marine Record.*

⁂

The Dixon Crucible Works, of Jersey City, which has been in the hands of Receiver Edward F. C. Young for nine years, was formally restored to the hands of the stockholders August 1 in pursuance of a recent order in chancery discharging the receiver because of his having re-established the company's solvency. When the formal transfer had been signed, Mr. Gopsill resigned the presidency, and Mr. Young was elected in his stead. The offices of secretary and treasurer were combined, and Mr. Walker was chosen to fill them. Since the company was placed in his charge by the Chancellor, Mr. Young has paid off the debt of the company, amounting to $1,700,000.

⁂

There were shipped in July three engines from the Baldwin Locomotive Works for the new railroad from Jaffa to Jerusalem. This road is said to be the first one in Palestine, and is being built by a French company for the Ottoman Government. The engines are moguls, with three pairs driving wheels and two-wheel driving trucks in front, and eight-wheel tenders. They are one metre (about 39″) gauge. The cylinders are 15×18 inches, and the driving wheels are 41 inches in diameter. The engines aren amed Jaffa, Jerusalem and Ramleh. At the Baldwin Locomotive Works ten very heavy engines are being built for the Mexican Central Railway, twelve for the Interoceanic of Mexico, twelve for the Mexico & Pacific, and eight for Japan.

⁂

The detailed report of the Engineer Board on the late official trial of the cruiser '*Philadelphia*' has been received at the Navy Department. It presents some interesting facts in regard to the performance of the vessel which have not before been published. It tends to show that the vessel did not do quite as well as she could have been made to do. The revolutions of the screws were: Starboard, 119.8 per minute; port, 119.9. The steam pressure in the boilers was easily maintained at 160 pounds, and steam was blowing off through the safety valves much of the time. The other steam pressures were: at high-pressure cylinders, starboard, 151 pounds; port, 154 pounds. At first receivers, starboard, 57.6 pounds; port, 56.5 pounds. At second receivers, starboard, 24.5 pounds; port, 24.3 pounds. Vacuum, starboard, 24.3 inches; port, 24.67 inches. Air pressure in firerooms, 1.5 inches. Slip of screws, starboard, 18.43 per cent.; port, 18.49 per cent. Speed, 19.68 knots per hour.

⁂

The Pacific Gas Engine Co., of San Francisco, have recently fitted a double engine of 15 h. p. into the schooner '*Moonlight,*' as an auxiliary, and have succeeded in propelling her at 3½ miles an hour, with a consumption of 2 gallons of gasoline, in money equal to 45 or 50 cents, which, divided by distance, makes less than 15 cents a mile. This must be qualified by the statement that the '*Moonlight*' is built nearly on the old Dutch principle of a "true cube," which was 100 feet long, 100 feet wide, and 100 feet high. She is 78 feet long, 24 foot beam, and carries 300 tons, or 75,000 feet of timber, so her propulsion is much the same as driving a "pontoon." Continuing our figures, and rating interest, attendance, fuel, room and depreciation, at 75 cents an hour, it amounts to about seven cents per ton per mile, which is certainly cheap enough. The main thing, however, is the saving in time and towage, getting into and out of port promptly, and pulling out of calms. We are sorry the experiment has not been made in a vessel more fairly suited for the purpose.—*The Journal Industry.*

⁂

The '*Maine*' is the first armored cruiser ever owned by this Government. Her displacement is 6,648 tons. Her hull and machinery cost $2,500,000. Her speed, according to the requirements, is seventeen knots and her engines, driving twin screws, are of the vertical triple-expansion type. The protection of the '*Maine*' consists of an armor belt of steel 180 feet long and 11 inches thick, the two forward ends being joined by a six-inch armored athwartship bulkhead. Above the belt and below the turret oval redoubts carrying ten-inch armor protect the turret bases, loading tubes and machinery. The turret armor itself varies in thickness from 10.5 inches to 11.5 inches.

An interesting feature of the '*Maine's*' machinery is the rubber valves capable of resisting heat of 320 degrees. No rubber valves of such strength have ever before been made in America. The contract was taken by the Mercer Rubber Company of Trenton, which made the '*Baltimore's*' valves, and which has successfully done the work required for the '*Maine.*'

⁂

The gist of the report of the Labor Commission of New York is contained in a general summary by Commissioner Peck, which could not be put in more concise language. It is as follows:

"The strikes in all trades and for all causes in the five years, 1885-'9, as respectively detailed in reports of this bureau, number 9,384. Of these 4,432 were successful; 1,434 compromised, making 5,866 to be classed as successful; 3,468 unsuccesssul. Strikes were pending in 50 establishments at the close of the report. The persons engaged numbered 338,926. The reported losses in wages were $8,000,601.30; expenses of conducting strikes $1,192,644.44. The estimated gains for one working year were $5,382,337, and for the five years it was $18,623,060.77. This does not include the piece trades, such as the printers, shoemakers, and cigarmakers, in which large gains were made but could not be estimated. Loss to employees from all causes, $5,113,693.15. From this return it will be seen that the gains go near to balance the actual cost of strikes and the loss to employees, $6,305,957. The estimated loss of wages—over $8,000,000—is omitted from the comparison because it is only estimated, not actual, and so is uncertain, and may be to a large amount only a worker's displacement, with employment elsewhere. If, however, the $8,000,000 were a positive loss, the gain in wages would be a strong offset. On the whole, the strike pays; for in three years the sum of all losses would be recovered and the advance rates maintained. Where a demand for better wages or shorter hours is successful, the improvement becomes a trade rate or rule, and is maintained until a general re-action through 'bad times' or other cause sets in. In the building trades 186 bricklayers received an advance amounting to $52,403. This advance was by trade usage maintained, consequently the gains are fairly estimated at $209,612 for the term covered by this investigation. In like manner, 1,137 carpenters, in 1886, received a gross advance of $395,207, which was maintained, so that in four years their gains would foot up $1,582,828. This is all to be placed to the credit of the organization."

◆

The Manhattan Elevated Railway is having three of its locomotives changed to compounds, the alterations being made by the Rhode Island Locomotive Works. The work of these engines will be watched with marked interest, for it will show what a compound engine will do under largely varied requirements. It has been considered that the compound should be designed for particular service and kept exclusively in that, in order to obtain the best results. We will now soon have shown to us what the compound will do under the marked variations in work which are characteristic of elevated railway operation.—*Railway Master Mechanic.*

We take the liberty to say in advance of the experiment that it is a useless one. If there is any place where a compound engine is working at a disadvantage it is under constant stopping and starting. All that is known of the compound engine warrants this assertion. Working at certain grades of expansion under certain ranges of temperature, the compound engine is more economical than single cylinders worked under the same conditions. Now, if we use the compound engine at any and every grade of expansion and under all ranges of temperature (as it would be constantly stopped and started), it is of no more value than any other type.

Mr. Forsyth, of the Union Iron Works, San Francisco, described to us some time since an arrangement of a fan "alongside" the chimney of a vessel, the gases being deflected from their direct course, through the fan, when artificial draught was used, and passing straight upward with natural draught. The circumstances of construction, looking at it in a mechanical sense, favors this method, especially in the case of oval flues, and the wonder is that ever fans were placed directly in the line of the flue and the course of the gases diverted for natural draught. With inward draught a stoke hole is cool, and no gases are expelled into a ship. In California forced draught is used for burning culm, lignite, or other low grade fuels. The fire-front and breeching of boilers become red hot. The gases and smoke are blown out, and the whole system is a nuisance in many ways. With a by-pass flue and an induced draught all would be changed for the better, and the effect improved in every way.—*The Journal Industry.*

◆

Prof. De Volson Wood shows by a recent paper that with an efficient ammonia system for making ice, the cost is, at three pounds of coal per h.p. per hour for the engine, one pound of ice for 21.93 pounds of coal. At 30 pounds of steam per h.p. per hour the cost of a pound of ice is 2.19 pounds of steam.

◆

On one of the great railway systems of this country there are locomotives which have been in service 36 years; 13 have been in service 25 years, 39 for 20 years, 85 for 15 years and 112 for 10 years; the average service of all on the line is 11.82 years.

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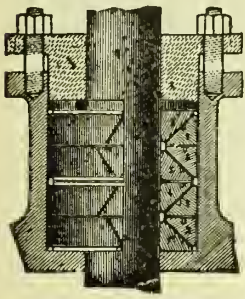

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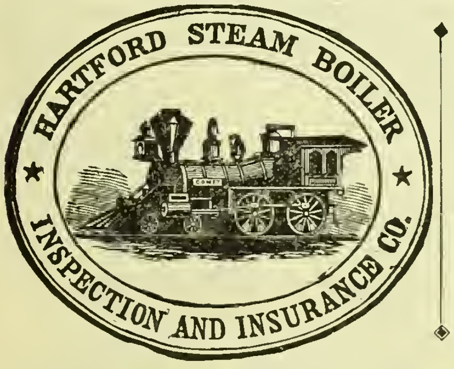

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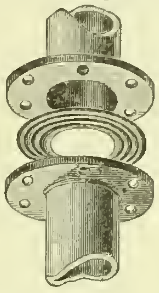

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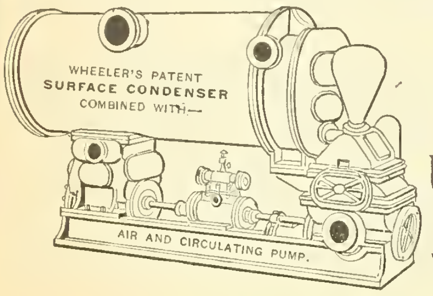

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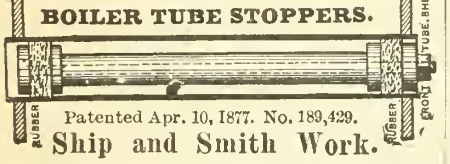

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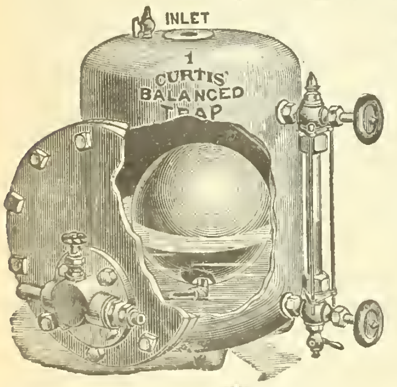

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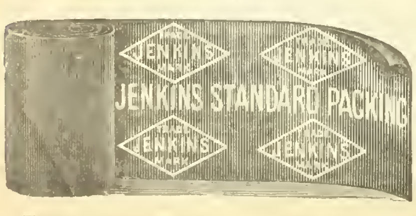

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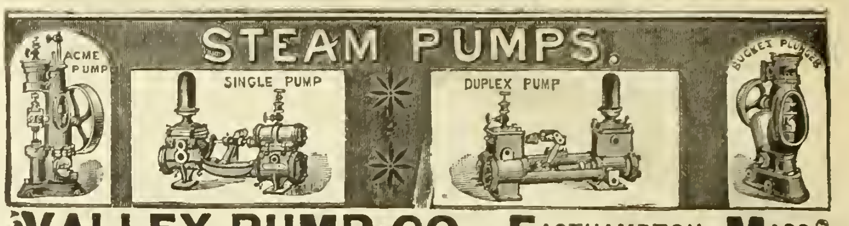

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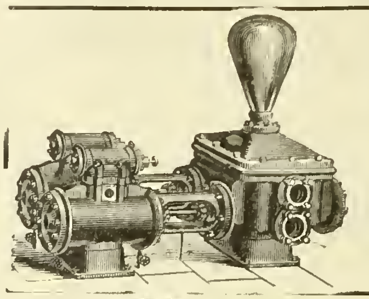

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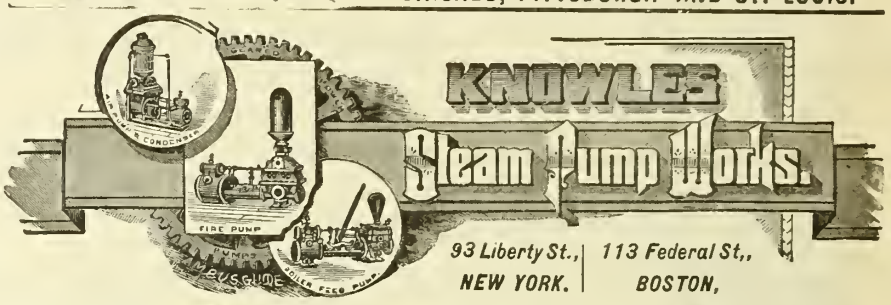

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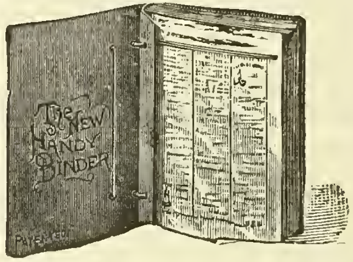

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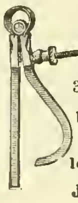

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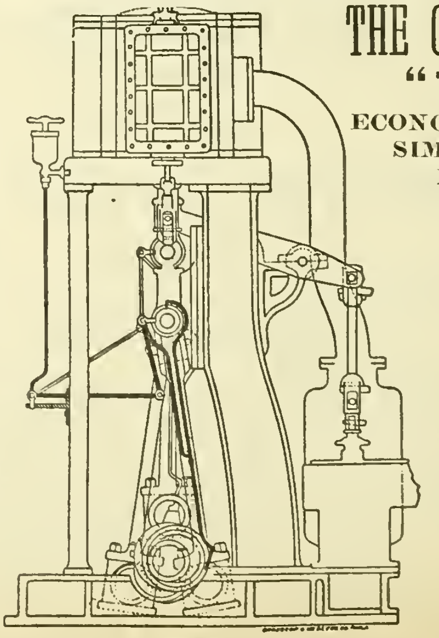

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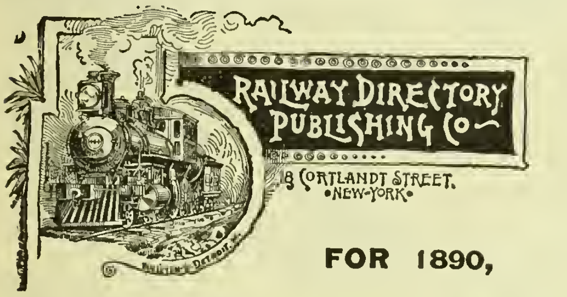
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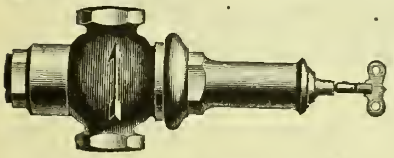

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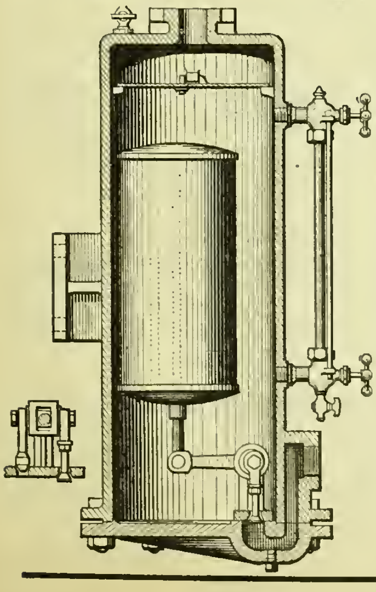

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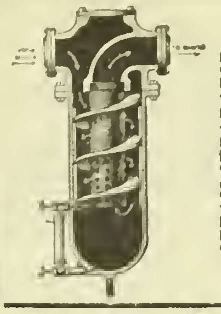

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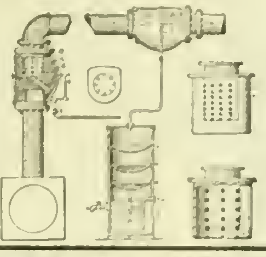

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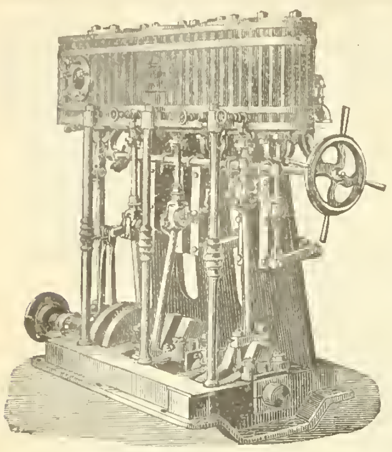

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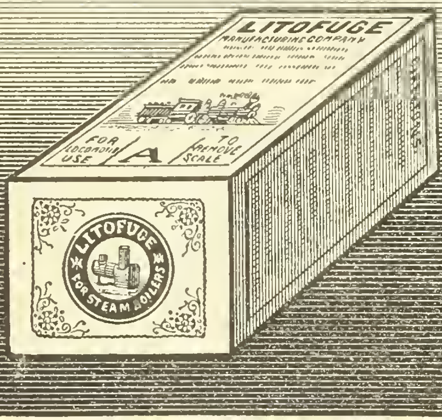

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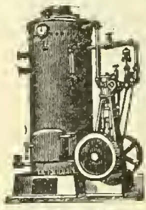

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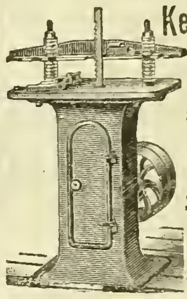

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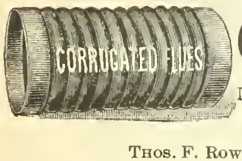

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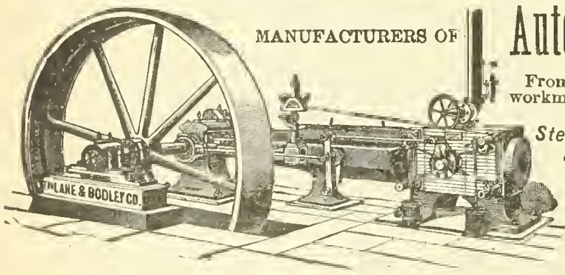
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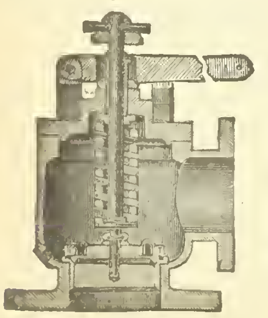

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THE ENGINEER.

NEW YORK

New Series, 1883, 1888. **Vol. XX. No. 5.**
Tenth Year of Publication.
STEAM ENGINEERING, APPLIED

$2.00 per Annum. - Single Copies, 8 Cents
August 30, 1890.
MECHANICS, AND THE ALLIED ARTS.

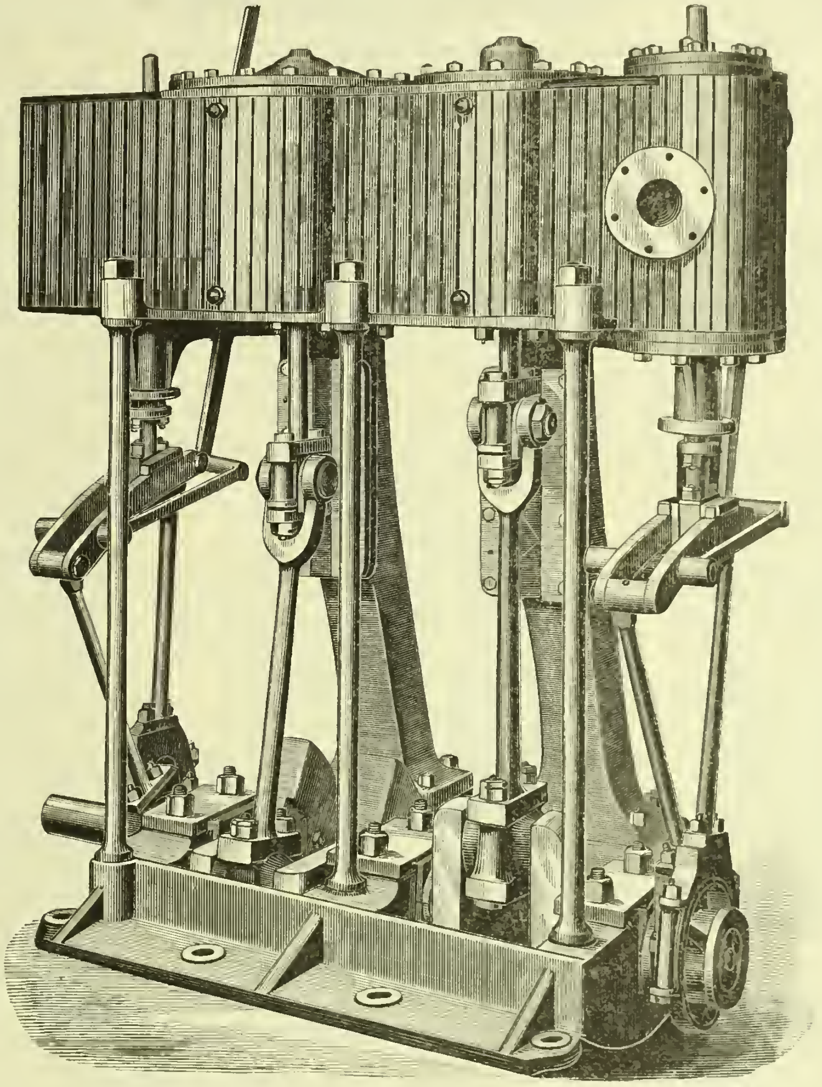
COMPOUND ENGINE FOR STEAM YACHT.

By the Detroit Dry Dock Works.

The engravings show a compact and well-proportioned compound engine for small yachts recently built by the Detroit Dry Dock Works, Detroit, Mich. These engines were designed by Frank Kirby and are 10″ h. p., 16″ l. p. and 10″ stroke, and have given good results.

The propeller is 3′ 6″ diameter by 5 feet pitch, and the engines drive it at 310 revolutions per minute with 120 pounds steam. The engines are high pressure, but can easily be made condensing if so wanted, by a keel condenser. The boat these engines drive is 72 feet long by 12 feet beam.

We shall publish sectional drawings to scale of these engines in a later issue.



◆

Not long ago a fireman was killed on the B. & O. on account of a broken side rod, and in a claim for damages by relatives several good arguments were brought up to show that the company did not use a good or safe rod. There is no doubt that a strap rod would be all right if keyed solid, and the right length at the start—and left alone—but it is their adjustability that makes them unsafe and is possible to change their length. There are a great many locomotives using a strap at both ends of the side rod; this means the shortening of the rod every time it is keyed. We have yet to hear of a solid ended side rod breaking; they rattle a little, and they ought to; no side rod is safe that is a perfect fit. The boxes must go up and down unevenly, and the rod should be loose enough to adapt itself to the changed distances between pins without undue strain. There is altogether too much keying of side rods where keying is possible. The solid ended rod prevents all "monkeying" in the shop or on the road, and has been a success from the days of Ross Winan.—*Locomotive Engineer*.

◆

A point to be considered is the fact that while the small carpets of Persia go under the general designation of rugs, it is a serious mistake to consider them all as carpets of small size intended to be trod on by heavy shoes. Persians when at home take off their shoes, and thus a carpet of fine delicate wool and design will last for ages, and improve with use such as this. A large proportion of the rugs of Persia, and especially the finer grades, are never intended to be laid on the floor, but to cover divans or tables, or to hang as tapestries and portieres.

◆

To clean marble, mix whiting with common soap till thick as paste. Spread it on the marble and leave it for a couple of days. When the paste is cleaned off the stains will also be removed.

Drift is the gunner's term for the observed fact that a bullet always has a tendency to curve off toward the side to which the rifling turns. In the case of a weapon rifled from left to right the bullet goes to the right; in a contrary case to the left. The most probable cause of this is that as the bullet is falling it must rest on a cushion of condensed air, and on this it naturally rolls or revolves (with an enormous amount of what the machinists call "slip"), though it is only fair to state that there are many conflicting theories about "drift." One thing is sure—we can calculate on it to a certainty, and take steps to counteract it. Should the bullet drift to the right, set the rear side sufficiently to the left, or *vice versa*. A few years ago most arms were rifled from left to right, but recently it has been found that the reverse is better, as it rather counteracts the pull-off, which is always to the right. The trigger, as we all know, should be gently pressed until the arm is discharged, but in practice it is often jerked slightly, dragging the muzzle to the right.—*Shooting and Fishing*.

◆

Glass may be decorated in any design without firing by applying with a pencil a solution of silicate of soda or potassium, to which water colors are added, with zinc white.

◆

No solder for aluminum has been found yet.

ELECTRIC LIGHTING BY BATTERIES.

Hollis, L. I., one mile east of Jamaica, is brilliantly illuminated by electric lights. The remarkable thing is that the light is not produced by machinery, but by a system of primary and secondary batteries, on the same principle as in telegraphy. This is the invention of William P. Kookogey, of 97 Pulaski Street, Brooklyn, superintendent of the electric signal system of the West Shore Railroad. The plant occupies a space of 16×3 feet. Hollis has about 300 inhabitants and forty houses. Streets and dwellings are both lighted by the new system. There are twenty-three street lights at present in operation, each of about 25 candle power. Thirty more street lamps have been ordered.

Kookogey's batteries have been patented, and have been in use for other purposes for some time. Lieut. N. G. Whistler, U. S. A., first tried them for the discharge of ordnance at Fort Wadsworth, and was so much pleased with them that they have been adopted by the general government. The electricity is produced by a simple consumption of zinc and carbon, the principal patent being on the fluid, called chromine by the inventor, in which four carbon sticks are immersed. This fluid costs but three cents a pound, is made by treating bichromate salts with sulphuric acid at a boiling temperature, and leaves, it is said, absolutely no residuum, the consumption being 98 per cent. To run the lights at Hollis two rows of fifty jars are required, and if the lights are increased to 300 to light Jamaica, three more rows of fifty jars will have to be added. Ordinarily the lights will give sixteen-candle power for houses and more than twenty-candle power for streets. The advantages claimed for the system are the absolute safety of the wires—any one can handle them without inconvenience, the steadiness of the light, and the cheapness when only a few lights are needed. The charge per light is $1.12 per month.—*N. Y. Sun*.

◆

This ineffable silliness appeared in the New York *Sun*, August 26:

> "WHAT IS THE MATTER WITH THE 'PHILADELPHIA'? SHE PITCHED AND NOW SHE LISTS.
>
> The speed of the new cruiser '*Philadelphia*' first became a subject of criticism because of her pitch. Now her propensity to list is being discussed, and by some she is credited with tendencies to avoid riding on an even keel, which interferes with her swiftness."

Some little discussion was had relative to the pitch of the screw on the '*Philadelphia*,' but this poor man transfers the pitch to the hull! It is amazing that men should be sent out to report matters they have not the faintest conception of.

"First she pitched, and now she lists." Is there a man living who could write such a line as that about a ship?

COMPOUND INTEREST TABLE.

Constructed by Frederic R. Honey, Ph.B., Yale University.

	Double.	Triple.	Quintuple	Septuple.
Rate per cent.	69.3197	109.8692	160.9554	174.6051
From 1 to 10	.3431	.5438	.7967	.9632
" 11 " 20	.3382	.5360	.7853	.9494
" 21 " 30	.3336	.5286	.7745	.9364
" 31 " 40	.3292	.5217	.7643	.9241
" 41 " 50	.3251	.5153	.7548	.9126
" 51 " 60	.3213	.5092	.7460	.9020
" 61 " 70	.3177	.5036	.7377	.8920
" 71 " 80	.3144	.4983	.7300	.8826
" 81 " 90	.3112	.4933	.7227	.8737
" 91 " 100	.3083	.4886	.7158	.8654

By means of the accompanying table, it is easy to ascertain the number of years which any sum of money put out at compound interest may be doubled, tripled, quintupled, or septupled. The method of using the table is illustrated by the following examples:

Ex. I.—*To find the number of years in which any sum of money put out at* 15 *per cent. will be tripled.* Look down the vertical column under *rate per cent.* for 15; it lies between 11 and twenty; carry the eye along this horizontal column until it reaches the vertical one under the word *triple*, and the figure .5360 is found; multiply .5360 by 15 (rate per cent). The product is 8.04; add this figure to that at the head of the column, viz.: 109.8692; divide the sum, viz., 117.9092, by 15; the quotient 7.86 is the number of years required.

Ex. II.—*To find the number of years in which any sum of money put out at* 25 *per cent. will be quintupled.* Look down the vertical column under *rate per cent.* for 25; it lies between 21 and 30; carry the eye along this horizontal column until it reaches the vertical one under the word *quintuple*, and the figure .7745 is found; multiply .7745 by 25 (the rate per cent.); the product is 19.3625; add this figure to that at the head of the column, viz., 160.9554; divide the sum, viz., 180.3179, by 25; the quotient, 7.213, is the number of years required.

By the same table it is easy to determine the number of years in which a sum of money may be quadrupled, by doubling the number of years in which it will be doubled; sextupled, by adding the number of years in which it will be tripled to the number in which it will be doubled; octupled, by tripling the number of years in which it will be doubled, etc.

The above statements suppose interest to be payable *annually*. If payments be made *half yearly*, the calculation must be made for half the rate per cent., and the answer will come out in the number of half years, *i. e.*, the answer must be divided by 2 in order to ascertain the number of years. Also, if payments be made *quarterly*, the calculation must be made for one-quarter the rate per cent., and the answer divided by 4 in order to obtain the correct result.—*Scientific American.*

◆

THIS account of the recent disaster to the '*New Orleans*' Ss. of the Cromwell Line, is the work of a reporter on the Boston *Herald:*

> A furious gale was blowing. Just when the tempest was at its height, a tremendous report was heard below, and the engines whizzed round at a fearful rate. The engineer knew what that ominous noise meant, and immediately stopped the engines, thus avoiding disaster. The piston rod was broken.

This is very fine; the engines "whizzing" round after the piston rod had broken is reprehensible.

◆

THE impossibility of making the average man understand the nature of the duties of an engineer is well shown by a question put to a young man who had recently entered a shop to learn the trade. This query was:

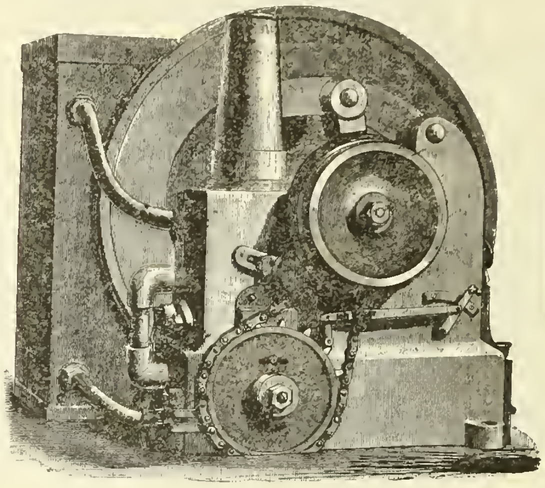
"Well, how do you like the foundry?"

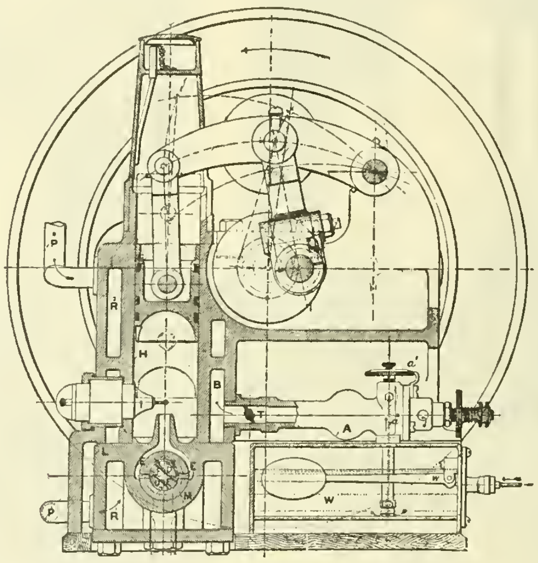
When the querist was told the young man was not in the foundry, but in the machine shop, he failed to perceive any difference. It was all "foundry" to the outsider.

BUTLER'S DOMESTIC PETROLEUM-MOTOR.

THE small motor illustrated is designed for many applications. The one illustrated is about one-sixth horse-power, which will perform continuously that which is too fatiguing for hand or foot work.

In fig. 1 is a perspective view, showing the engine in front of the small tank containing water for the jacket. In front is seen the pitch-chain wheel, which is fixed to the end of the valve, by means of which the charge of petroleum vapor and air is admitted. The small handle, which controls a throttle-valve for starting and stopping, is also seen in fig. 2. *W* is a petroleum well having the float-valve, *w*, connected by pipe to a half-gallon supply can, which holds oil for a day's run. Over the well is an atomizer, *A*, into which oil is induced to flow up the pipe a^2 by air drawn through a nozzle by the motor piston. The valve, a^1, regulates the oil feed. The mixture of air and oil spray formed in this atomizer is volatilized in the chamber *B*, and distributed to the cylinder by the valve *V*, which has inlet and exhaust ports, *D* and *F*. The port *D* communicates by *C* to the chamber *B*, and the exhaust ports *F* by *G* with the exhaust pipe. Communication of these ports with the cylinder is by the ports *E* in the seating *M* and cover *L*. The piston works in the four-stroke compression cycle, and the valve rotates once for every two complete revolutions; it is kept up to its seat by a spring at *S*. The speed is controled by a throttle valve *T*, connected to the hand lever, seen in the perspective view. The ignition is effected by the passage of an electric current across terminals carried by the insulator *I*, which is induced in a coil placed in connection with a small special bi-chromate battery at the right periods, by means of contact plates on the commutator *J*, at the back of the valve-chain wheel *K*. When not using the motor for more than an hour at a time, an ordinary bell battery is said to supply sufficient current. Overheating of the valve and cylinder is prevented by water circulation through the P^1 to the jacket R^1, thence to the jacket R^2, whence it returns by pipe P^2 to the tank—about five gallons. The cylinder and body are in one casting. The piston, being connected by the two short rods and arm to the crank—$1\frac{5}{16}$ in. radius,—allows a somewhat quicker outstroke than return, besides rendering the motor very compact. The size of the cylinder is 2 in. by $3\frac{7}{8}$ in. stroke, and the revolutions are variable from 250 to 800 per minute. The total height of the motor is $16\frac{1}{2}$ in.; width of base, 7 in. by 12 in., and the weight, without water tank, 110 lbs.—*London Engineer.*





◆

THE river Rhone, as it passes through Geneva, Switzerland, is divided by an island covered with buildings, and an engineer proposed that the right arm of the river should be reserved for running off the water, while the left arm, transformed into an industrial canal, was to conduct the water into a building to be constructed in the bed of the river, and in which would be placed, as they were required, twenty turbines with 4,400 net h.p. The whole of this work is now done. The method of distributing the motive power gave rise to a good deal of discussion, but the system of transmission by water under pressure was adopted, and the municipality decided to make two canalizations, one with low and the other with high pressure, the latter with an ascending force of 460 feet. The enterprise was a very considerable one, for it was necessary to completely empty the two channels of the Rhone in succession. This was done in order to deepen the bed of the river and give it a gentle slope from the mouth of the lake to the turbines. Opportunity was taken to construct upon the banks of the stream large sewers which run along the banks of the lake and of the Rhone for a distance of more than three miles. These sewers, which cost £96,000, empty into the Rhone some way below the town, and thus prevent the water which is used by the inhabitants from being contaminated. From a hygienic point of view, this has been most successful, the number of deaths from typhoid fever last year being only 9 out of a total population of 73,000.

◆

THERE is one condition of the ocean steamer that greatly adds to the discomfort of a heavy beam sea, and that is the piano. People may be sick, delicate ladies may be sleeping after a long, restless night, passengers may be attempting to write letters home, but the piano is bound to be played. I cannot persuade myself that more than ten people out of every hundred who make a voyage have the least liking for the kind of music that is threatened by a ship's piano. If there be one place in the world in which a man should consider himself safe from the petty harassments of shore life it is a ship. He escapes the telegram, the postman, the tradesman with his little account, and a hundred other things. Why, then, should the piano follow him? A piano on board ship is more vexatious and intolerable than a German band on shore. You can drive a German band away, but it is not easy or pleasant to go up to a lady who, with both feet on the pedals, is hammering through a piece of complicated and wrangling music, and ask her to desist because you want to read or your wife wants to sleep.—*W. Clark Russell.*

◆

ALL the can openers in market are defective in one point—they cut out a flat disk on top of the can. This leaves one edge at the top projecting over the opening, which is very objectionable with some kind of canned goods, salmon for instance. A better way to make a can opener would be to have it act on the side of the can, cutting the top bodily off.

◆

SPEAKING of expanding steam in one cylinder, we said in the last issue:

> The action of the '*Hudson's*' engines is all that could be asked, yet she uses steam at 90 pounds per square inch cut off at $\frac{1}{16}$th of the stroke.

For $\frac{1}{16}$th read one-tenth of the stroke.

AMERICAN AND ENGLISH LOCOMOTIVES.

We suppose this question never will be permanently settled—whether the English locomotive is better than the American, or vice versa. By this the general type is meant; mere workmanship has nothing to do with the question. Good and bad workmen are of all countries; there is no need to complicate the argument by the question of workmanship. There are just as many slouches in England in proportion to the men engaged as there are here; the slouch—like the poor—we have always with us. The question then, narrows to the actual work done by the engines of each country for a given amount of coal in a certain time, but this is a most difficult thing to determine. No one can say that mere train load represents all the conditions involved, by any means, unless the engines run over the same track. In running twenty miles, an American locomotive with the same train-load as the English locomotive, may lift itself over grades thirty feet high many times, for which extra duty it must burn extra coal. So to estimate the work done by the locomotives of each country the work must be identical in each case, or in all cases. How impracticable it is to determine this any person can see for themselves with a moment's thought. Inspection of reports proves nothing, however elaborate they may be. Experiments prove nothing, and assertions on either the American or English side prove nothing; anyone can assert. Neither does $x+y$ help in this case, the whole matter to be settled being whether so many tons of work are done in such a time by a certain expenditure of fuel. Finally, it needs a man from another world than ours to act impartially—where the words "English" and "American" are unknown. The Englishman may think he is impartial, and may intend to be, but he refers everything to his English experience and English standard, and things are good or bad in comparison with it. The American is just the same—it is not in human nature to be otherwise. Men of any country cannot abandon the teachings and experience of their lives and embrace others by any amount of experiment or elaborate comparison. Comparing the work of two different makers of locomotives is a most elaborate and arduous undertaking from an engineer's point of view. From the debating society aspect of the matter, we can settle it in a sentence—the American is the best, but engineers are not satisfied with mere words from anyone; they want pounds and ounces, feet and inches, and from that testimony there is no appeal.

◆

It is generally supposed that the use of the incandescent electric lamp completely obviates the blackening of ceilings. This is a mistake, however, as incandescent lamps do to some extent cause blackening. It is probable that the blackening from a gas lamp is not due to unconsumed carbon, but to the deposition of particles from a current of hot air; the incandescent lamp causes a current of hot air, which also deposits black particles; but, unless the lamp is near the ceiling it is not easily observed, as the current of air is, of course, smaller. It may be noticed in connection with this subject, that the mica guards and glass bells arranged over gas burners do not themselves blacken, and do not appreciably lessen the blackening of the ceiling. It is therefore probable that the deposit only takes place from hot air to a cold surface.

◆

A new "metallic" packing made abroad is thus described: "It is made of one piece of asbestos cloth saturated with grease, folded and covered on the outside with black lead. The folds are fixed together with nails of lubricating metal, specially manufactured and forming a metallic surface to the rod. It is claimed that the packing is very elastic and that the screwing down of the gland increases this elasticity."

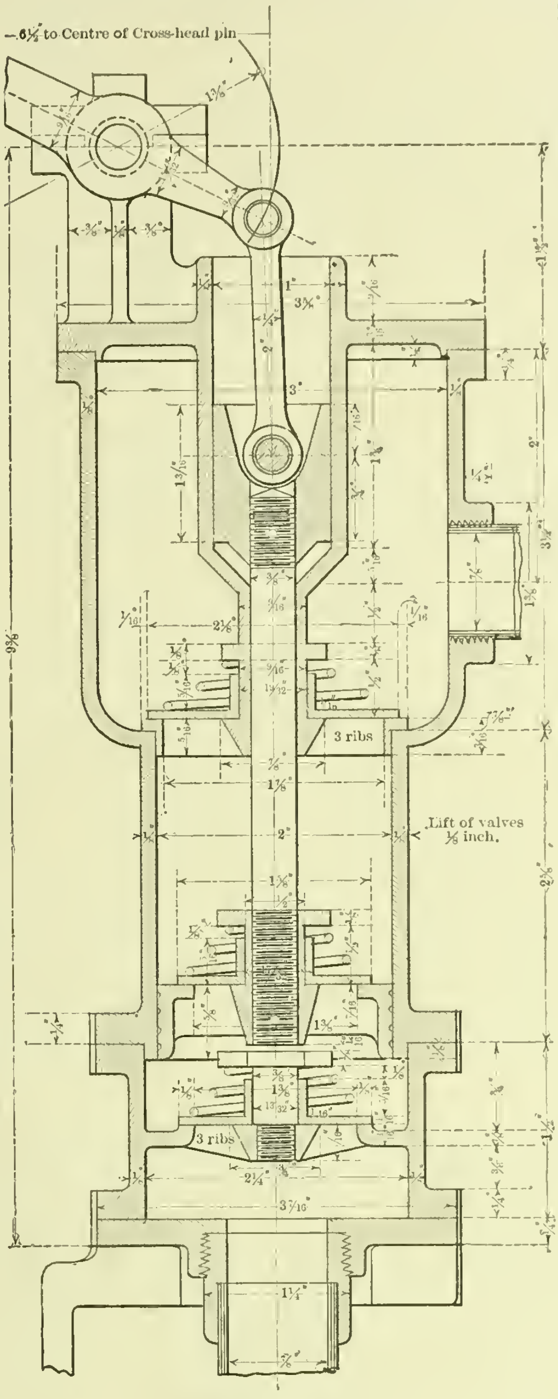
A daily paper reporter, commenting upon the heat of foundries, said recently that a thermometer held within four feet of the cupola when the iron was being run off showed 142°, and he urged that it was not fit for human beings to work in such a place. It is a good deal hotter than 142° inside the cupola, too, but the temperature of foundries is not 142° on an average.

◆

COMPOUND LAUNCH ENGINE. No. 5.

By the Bureau of Steam Engineering, U. S. N.

The engraving in this issue represents the air pump, all marked finished sizes. It is probably the smallest air pump of its type in existence, being only 2′ in diameter. All the gear belonging to it will appear in later issues.



◆

A bill is now pending in Congress which appropriates $30,000 for a monument to John Ericsson. It provides that the Secretary of the Navy, the Chairman of the Library Committee, and the architect of the Capitol, shall designate a suitable public reservation in the City of Washington as the site, and contract for the erection of the monument.

◆

The response to the demand for electricity for lighting has been the production of dynamos of 95 per cent. efficiency, a far better result than is obtained in steam engines, and conversely these dynamos can be used as motors with the same efficiency.—*Dr. Schuyler Skaats Wheeler.*

Yes, but, Doctor Schuyler Skaats Wheeler, you must have the steam engine before you can have any electricity.

MEAN SPEED OF A VESSEL.

Page 322, *Reed's Hand Book* (an excellent manual, by the way) gives this problem:

"A steamer ran the measured mile in 5 minutes 10 seconds with the tide, and 7 minutes 30 seconds against the tide; what was her correct rate of steaming?

Knots per hour with the tide

$$\frac{60\text{ m.} \times 60\text{ s.}}{5\text{ m. } 10\text{ s.}} = \frac{3{,}600}{310} = 11.612$$

$$\text{Against } \frac{60\text{ m.} \times 60\text{ s.}}{7\text{ m. } 10\text{ s.}} = \frac{3{,}600}{450} = 8$$

$$\text{Mean of the speed } \frac{11.612 + 8}{2} = \frac{19.612}{2} = 9.806 \text{ knots per hour.}$$

This is a clumsy way of getting at the matter, and the one subjoined is much shorter. The vessel ran 1 mile in 310 seconds with the tide, and one in 450 seconds against the tide, a total of 2 miles in 760 seconds, $\frac{760}{2} = 380$ seconds for one mile. 3,600 seconds in one hour, divided by 380 seconds, gives the rate per hour: $9\frac{5}{10}$ knots per hour.

◆

Commenting upon the bracing of a steam dome, *The Locomotive* says:

"The most important point to be noticed, however, is, that the ends of the braces are secured by single rivets only, which are entirely inadequate to bear the stress that comes upon them with safety. A $\frac{3}{4}$-inch rivet has a sectional area of 0.442 sq. in., and if we allow it 7,500 lbs. of safe working strain per square inch, it will bear 7,500+0.442=3,315 lbs. Four such rivets will, therefore, safely bear 4+3,315=13,260 lbs., while, as we have seen, they are called upon in the construction to carry a total load of 56,560 lbs., that is, they are loaded to over four times their safe working strain. We have assumed in this calculation that if the rivets failed they would fail by pulling apart in the shank. In reality the heads would pull off before the shank parted, so that the bracing is even less secure than the calculation indicates."

This is one of the commonest faults in steam boiler braces.

◆

A steam lifeboat, recently launched at London, is built of steel, with fifteen water-tight compartments. The boiler and engine-rooms are about 3 ft. above the main deck, and are closed by iron covers, air being supplied by forced draught. The passengers' space is abaft the engines, and will hold about thirty persons. The mode of propulsion adopted is a turbine, taking in water through the bottom of the boat at its apex, and discharging when it has attained its maximum velocity through tubular orifices on each side. About a ton of water per second is discharged. The speed at which the vessel ran was over eight knots, and her hydraulic system of propulsion gives her great handiness. From full speed ahead the vessel can be brought up in thirty-two seconds, and way can be got on her again in four seconds.

◆

As it is difficult to obtain clear turpentine for microscopical purposes, I give other workers the benefit of my experience in rectifying the ordinary fluid, as follows:

Take one pint of common turpentine, and mix in a quart bottle, with four fluid ounces of 98 per cent. alcohol. Agitate well, and let stand until the two fluids separate. Decant the turpentine (which will form the lower layer) from the alcohol, and mix it with one pint of clear water. Agitate thoroughly, and let stand until the two fluids separate, then from the water decant the turpentine (which this time will form the upper layer), and, finally, mix with the turpentine about one ounce of powdered starch, and filter through paper. By the foregoing plan anyone may secure a pure, limpid and brilliant turpentine.—*The Microscope.*

◆

The Eiffel Tower is to be utilized for obtaining a very high pressure by means of a tube running from top to bottom and filled with mercury. A pressure of 400 atmospheres is obtainable.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

TO FIND WEIGHT OF METALS.

Editors ENGINEER:

DEAR SIR—Please tell me what are the decimals to find out the weight of cast-iron, wrought-iron, brass, copper, lead and steel, the number of cubic inches being given. W. NUTTING.

New Orleans.

For cast-iron the multiplier is .237 per cubic inch, because that is the weight of a cubic inch in fractions of one pound. Wrought-iron .279; brass .303; copper .332; lead .410; steel .283—all decimals.

◆

VACUUM.

Editors ENGINEER:

I saw some remarks upon vacuum in a letter written by one of your correspondents a few issues back. Would you inform me why condensing steam by cold makes a vacuum?

New York. STUDENT No. 2.

[When steam enters a closed vessel it expands and fills the entire space, driving out the air through the foot valves. Now, if this steam is condensed it occupies (as water) but a very small portion of the space it did at first. There is then a void above the condensed water, which is the vacuum.—EDS.]

◆

METAL REAMERS.

REAMERS, as used in an engineer's shop, are implements that continually fail to meet the user's expectation. They either break, wear under size, or make untrue holes. Various modifications of them do not seem to bring much improvement; indeed, the older ones are the best, as I hope to explain presently; but as to this I would like to invite the opinion of your engineering readers.

Standard sizes for the cylindrical parts of machinery include holes as well as the parts that fit into them; indeed, the holes are the most important part, and a system of gauges is more a system of reaming than anything else. I propose to make some remarks upon reamers, of a particularly "heterodox" kind, among which the main one will be that common multibladed reamers are wrong in principle, and can never work well when there is no contact except with the edges. Talking recently with an old toolmaker of wide experience, especially in gun boring, he said: "There is nothing like a D-bit for boring true holes; no reamer or other tool can make a good hole without abutment." His meaning is the same as that in my remarks above respecting edges. There must be other support or "abutment" than cutting edges for any implement that produces true smooth work; nor is this a new discovery. Reamers with blades were made by John G. Bodmer more than forty years ago.

He had found out, doubtless by experience, that reamers without abutment would not make true smooth bores. Going still further back, even centuries ago, we find the bore of firearms, almost the only kind of true holes required, were made by square reamers, or others with an abutment of wood that partially filled the bore. Still later than Bodmer, I may cite the experience of J. Morton Poole, a celebrated and successful mechanic in America, who made a good many experiments on implements for making holes, ending up with reamers having a solid abutment of more than one-half the circumference of holes. Mr. Poole was the inventor of a very ingenious system of grinding calender and other accurate rollers, some of which required an axis of steel or iron, fitting the whole length. To make such holes he employed reamers up to 30 in. long, made substantially like that by Bodmer.

A common machine drill is a fair illustration of a multibladed reamer, in so far as the cutting support falls on cutting edges, and the result produced, although for obvious reasons less accurate than that of the reamer, the nature of the operation is the same. No one ever thinks of "drilling" a true smooth hole, unless it might be with a twist drill that fits closely in the bore, and thus gives an "abutment" for the cutting edges. If one goes into any machine shop where accurate smooth holes are required to be made, he will find in nearly all cases, perhaps all, some modification of a reaming apparatus, that is, with some kind of permanent support behind or opposite the cutting edges, and the problem arises, why not make all reamers to conform to this method? It will cost no more, perhaps less, to insert two or three blades leaving half or more of the stem or barrel for support of the cutting action.

Expanding or adjustable blades is an indispensable feature if gauge sizes are to be maintained. This is more easy to accomplish with a few than with many blades; besides the barrel, when it fills more than half the circumference of the hole, becomes a constant gauge for size. It is by no means an easy matter to adjust a many-bladed reamer without other bearing than the edges, even if the cam be moved out and in; it requires a gauge collar, and even then it is difficult to have all the edges bear uniformly.

On the whole, reaming seems to be one of those processes that has gone on from year to year, or even for generations, without such investigation as is applied to many other processes. It is common in Lancashire shops to find a complete set of one-blade reamers made on the premises at a moderate expense, and, I imagine, with a better result than can be attained with the fluted kind having edges all round. I have examined some of these tools, and at the same time the holes made, and the result confirms my opinion, that the simple old-fashioned reamers make the best holes.—*John Richards, in Industries.*

◆

THE '*City of Paris*' is 560 ft. long, 63 ft. beam, and 43 ft. deep, and 10,500 tons, the largest merchant vessel afloat in point of tonnage. The '*Teutonic*' is 582 ft. long, 57 ft. 6 in. beam, and 39 ft. 4 in. deep, and of 9,685 tons. She is the longest vessel afloat, but she is much narrower and shallower for her length than her competitor. The engines in both cases are triple-expansion. In the Inman liner the cylinders are 45 in., 74 in., and 113 in. in diameter, and in the White Star vessel 43 in., 68 in. and 110 in. The pressure in the former is 160 lbs., and in the latter 180 lbs. The propellers in the '*Teutonic*' overlap by 5 ft. 6 in. The indicated horse-power of the '*City of Paris*' is 19,000, and of the '*Teutonic*' 17,000, the proportion of tonnage to indicated horse-power being 1.80 and 1.75 respectively. We have now reached the record breaking period of the year, and in the next month or two good performances may be expected. One cannot but regret that the '*City of Paris*' is not now running, otherwise the contest might have been keener; but the remarkable improvement in the '*City of New York*' may partly make up for this. The steamers from Southampton are doubtless also preparing for good work, and doubtless when the newness gets worn off the '*Normannia*' she may show the way.—*Engineering.*

◆

THE thirty tons of coal which the '*Baltimore*' will burn each day of her cruise to Sweden cost the Government $3.50 per ton. It is estimated that she will cover the 3,650 miles to Gothenburg in twelve days, making the total cost of the coal $1,260. The use of the tug '*George Starr*' on the day of the Ericsson ceremonies cost the Government $100. The fifty shots fired from the '*Nantucket's*' battery and the salutes of twenty-one guns from the ships in the harbor and from Fort Wadsworth consumed a little over 400 pounds of powder, which, at 20 cents a pound, reaches something in the neighborhood of $100. These items, together with the incidentals, foot up perhaps $2,000, which represents the Government's total expense in its farewell ceremonies over the body of John Ericsson.—*N. Y. Times.*

Well, since Uncle Sam stole the Monitor system bodily from Capt. Ericsson, having never paid one cent for it, he need not cry over $2,000, more or less.

LATEST LEGAL DECISIONS ON TRADE.

REPORTED FOR THE ENGINEER.

[WE shall until further notice publish the latest decisions in courts of last resort upon topics of general interest to our readers. From these decisions they will be able to judge in a measure of their own chances in similar cases.]

Liability for Wharfage when Moored for Safety.—No wharfage can be collected from a vessel that is compelled to moor to a wharf for safety during a stress of weather, no fixed rate of charge being in use and the wharf a private one.—*Heron* v. *Marchioness, United States Circuit Court, Northern District of Florida, 42 Fed. Rep.* 173.

Obstructing the Boarding of Revenue Officers by Incoming Vessel.—A steamer was coming into New York harbor, being under the immediate direction of the master. A revenue cutter signaled for her to stop, that officers might come on board; the steamer paid no attention to the signals but kept on her course. Under this state of facts was liable for hindering and obstructing the boarding of officers within the meaning of the statute.—*The Barra contra United States, District Court of the United States, Eastern District New York, 42 Fed. Rep.* 160.

Seaman's Contract of Service.—Where a seaman signs articles for a definite voyage, and before it is concluded leaves the ship with the consent of the master, they are entitled to receive their wages at the rate specified in the shipping articles for the time they actually served.—*Waitshoan* v. *The Craigend, United States Circuit Court, District of Washington, 42 Fed. Rep.* 175.

Perilous Navigation.—Tugs navigating the East River in a dense fog do so at their own peril.—*The Mohawk, United States District Court, Eastern District of New York, 42 Fed. Rep.* 189.

Crossing Courses by Steamers.—A steamer attempted to pass through a gap between two vessels, thinking one of them would move in time to allow her to pass through. A collision occurred, which was caused by the negligence of the steamer, hence, her owners cannot recover.—*The Raritan, United States District Court, Eastern District of New York, 42 Fed., Rep.* 191.

Rate of Interest—How Governed.—The rate of interest upon a note not payable at any particular place, is governed by the law of the place where it was made and delivered.—*Clark* v. *Seawright, Supreme Court of Pennsylvania, 19 At., Rep.* 941.

◆

IT would be difficult to bestow too much praise upon the naval officers who managed the Ericsson parade. The precision of time with which the column moved and the exactness with which the embarkation coincided with the programme were features alike commendable and novel. The procession moved precisely at 2 o'clock; the embarkation took place just as the hands of the Produce Exchange clock stood at three. Every one of the boats was in place, and not a hitch occurred anywhere along the line. Much of the excellence of this systematized work is due to the officers who drew up and issued the blue prints. These were diagrams with the positions of each society clearly marked. The idea was novel, and it contributed largely to the accuracy and intelligent movement of each individual in the ranks. To the officers at the navy yard who had this very excellent affair in charge is due the credit for having arranged one of the best military displays that ever marched down Broadway.

◆

BRO. E. V. Ballard, First Assistant Engineer of the Ss. '*Herman Winter*,' of the Metropolitan Line Ss., holds an enviable record for fidelity to duty. In eleven years he has not lost one trip or one watch for any cause. Every time he is on hand on the platform when time is called. We doubt if there is another record equal to this out of this port for a similar length of time. Bro. Ballard holds first-class chief of ocean steamers certificate also.

◆

A contemporary says: "A company in Pennsylvania is to build cars of hollow steel tubes." Did it ever see a solid steel tube?

THE NEW PROTECTED CRUISER.

The announcement is made that a new protected cruiser of about 7,300 tons is to be built for the Government, and in former issues some allusion has been made to her. To recapitulate as briefly as possible:

The department plans call for a vessel 400 feet long; beam, 58 feet; draught, 23 feet; extreme, 24 feet; displacement, about 7,300 tons; speed sustained, 21 knots; and indicated horse-power, 20,500. The motive power will be transmitted through three screws, one amidships and one on each side, as in twin-screw vessels. This arrangement is not entirely new, having been adopted by the French for some of their later vessels, but it represents the latest advance in the steam engineering line where such great power is to be transmitted. If twin-screws were used, over 10,000 indicated horse-power would pass through one shaft; now each shaft transmits only 6,850, and the vessel has one more chance in case of breakdown.

The machinery and boilers were designed by Engineer-in-Chief George W. Melville, U. S. N., chief of the Bureau of Steam Engineering. There are three sets of triple-expansion, vertical, inverted cylinder engines. The center screw is about four feet six inches below the other two. Each engine is in a water-tight compartment, and the vessel may be propelled at a slow speed by the center screw alone; by the two outer screws at a medium speed; and by the three screws when the highest rate of speed is required. Each shaft is fitted with a disengaging coupling, so that when not in use the propellers are free to revolve. The steam pressure is 160 pounds.

Diameter of high-pressure cylinder	42 inches
Diameter of intermediate-pressure cylinder	59 inches
Diameter of low-pressure cylinder	92 inches
Stroke (common)	42 inches

The total indicated horse-power at 129 revolutions per minute and a forced draught of one inch of water, is 21,000 horses. There are eight main double-ended boilers in four water-tight compartments, and two single-ended auxiliary boilers on the berth deck. The air-tight fire room system of forced draught is used. Six of the double-ended boilers are 15 feet 6 inches in diameter and 21 feet 6 inches long, each having eight furnaces and 175.5 square feet of grate surface and 5,932.4 feet of heating surface.

Two of the double-ended boilers are 11 feet 8 inches in diameter, and 18 feet 8.5 inches long, each having four furnaces and 84 square feet of grate surface, and 2,870 square feet of heating surface. The total grate surface for the main boilers is 1,221 square feet, the total heating surface for the main boilers is 41,334.4 square feet. Each auxiliary boiler is 10 feet in diameter and 8 feet 6 inches long, with two furnaces, and has 32 square feet of grate surface and 968.5 square feet of heating surface. All the boilers are constructed for a working pressure of 160 pounds.

The contractor must guarantee an average speed in the open sea, under conditions perscribed by the Navy Department, of twenty-one knots per hour, maintained for four consecutive hours, and for every quarter knot above the contractor shall receive a premium of $50,000, for every quarter knot below the required speed there shall be deducted the sum of $25,000. The plans may be seen and examined at the department on and after August 20. The vessel must be completed within two and a half years after the contract is signed.

The plans, as outlined above, are an innovation, or in other words, an experiment, for which there is no precedent to base any expectation of success. Twin screws have not shown that they possess any especial advantages over single screws, even in the event of accident, as shown by the '*City of Paris,*' while the triple screw system has many disadvantages over twin screws which it is not necessary to specify here. They have been tried and found wanting in the Czar of Russia's yacht, the '*Livada,*' from which they were removed for inefficiency, and the '*Depuy de Lome,*' the French naval vessel in which they are now being placed, is yet to be tried. It would seem wiser to wait until the results of this vessel are known before experimenting at great cost ourselves. The horse-power of this new protected cruiser is not excessive, being only a little above 2.5 h.p. to the ton of displacement, while the total heating surface in the boilers to produce it is 41,334 square feet. This calls for a horse-power in the boilers for less than two square feet of heating surface. The grate surface is smaller than common, being 34 to 1, instead of 26 to 1, the usual practice. If the engines produce 21,000 h.p. at a cost of 3 pounds of coal per h.p. they will require 63,000 pounds of coal per hour, which calls for the combustion of only 50 pounds of coal per square foot of grate surface, well within possibilities.

We have only briefly adverted to this new ship as a matter of record, but we hope the plans will be changed before she is built, and the triple screws supplanted by twin screws.

THE LINK MOTION.

At the last meeting of the railway master mechanics, the committee on valve motions concluded their report as follows:

"Nowhere is the 'survival of the fittest' more pronounced than in railroad practice. The history of valve motions and devices to improve the link motion and those that were to supersede it would fill volumes. Many have been theoretically correct and very promising, but, after the crucial test, have resulted in failure; and the link motion remains in almost undisputed possession of the field.

"It has been urged against the link that it is not a scientific or true mechanical motion. This may be true, but the fact remains that fairly good results are obtained from it; that it will take more punishment in the shape of rough usage and neglect, and cost less to make and repair, than any other valve motion now being experimented with on locomotive engines.

"Your committee are led to believe that valve motions other than the link are experimental, owing to the difficulty of ascertaining data of the results obtained from them.

"The almighty dollar is always to the front, and no matter how theoretically or scientifically correct a motion may be, unless it costs less in every way than the link it will not displace it. It frequently happens that the poor results obtained from a locomotive are charged to the valve motion, when the cause may be found in contracted steam passage pipes, leaky valves or pistons, steam wire drawn through the throttle, and back pressure, caused by contracted exhaust nozzles. It is surprising what a change will be made in the back pressure line of an indicator card by slightly increasing or diminishing the opening in the exhaust nozzle.

"In conclusion, your committee are of the opinion that there has not been brought to their notice a valve motion more efficient for all-around work and general utility than a well designed link with large bearing surfaces—assisted in its work by steam passages and pipes of generous dimensions, free from sharp turns and bends—giving the link plenty and hot steam to distribute, and, most important of all, not crippled by a contracted exhaust nozzle."

FOR YOUNG AMERICAN ENGINEERS.

The steam laboratory of the Massachusetts Institute of Technology contains a triple expansion engine with cylinders of 9 in., 16 in. and 24 in. diameter, and 30 in. stroke, arranged to be run single, compound, or triple, as desired, for the purposes of experiment. This engine is of the Corliss type, and will be about 150 h.p. when running triple, with an initial pressure of 150 lbs. in the high pressure cylinder. It has a surface condenser and all the other apparatus necessary to adapt it to the purposes of accurate experiment. The laboratory also contains a 16 h.p. Harris-Corliss engine, and an 8 h.p. engine, used for giving instruction in valve-setting, etc. It is also equipped with several surface condensers, steam pumps, calorimeters, mercurial pressure and vacuum columns; apparatus for determining the quantity of steam issuing from a given orifice or through a short tube under a given difference of pressure; apparatus for testing injectors; and with indicators, planimeters, gages, thermometers, anemometers, and other accessory apparatus.

There are also available for the purpose of experiment, in connection with the work of these laboratories, two horizontal tubular boilers, one large Babcock and Wilcox boiler, and a Porter-Allen engine of about 80 h.p., also another boiler, a 40 h.p. Brown engine, a number of looms, and other apparatus in the workshops.

The most important addition to the equipment of these laboratories is that of the triple expansion engine, inasmuch as it is the first triple-expansion engine for a practical size that has ever been arranged for making experiments, and by its means the laboratories are placed in a position which will enable them to do work for the triple engine of a character similar to that done for the compound engine by the United States naval engineers in 1874, and also to make such researches with a triple or compound engine as were made upon single engines by Hirn, Hallauer and others. The hydraulic tank and stand-pipe places this laboratory in a position to perform some work of great value in hydraulic experiments which would be impossible without such apparatus.

[What opportunities the young man of to-day has, compared to what his grandfather had!]

◆

Railway travel in Chili has some disagreeable features, as, for instance, the recent strikes among the foreign engine drivers employed on the Government railroads, the drivers refusing to run under the direction of a Chilian superintendent, whom the Government appointed to have charge of the trains in place of the Scotchman formerly employed. At first this strike merely consisted in a refusal to work on the part of the drivers, who declared that they would not risk their own and other people's lives by attempting to follow the directions of an ignoramus who knows nothing whatever of railroading, on a track over which some thirty odd trains run every day. All traffic being stopped, the strikers were promptly arrested and put into prison, whereupon, they being mostly Englishmen, the British Minister demanded from the Government their instant release. They were liberated after a few hours in jail, and most of them have gone to work again, but that dissatisfaction is dangerously rampant is proved by the obstructions found daily on the track between Valparaiso and Santiago, and occasional stray shots from unknown hands, which come whizzing through the car windows, to the terror of unoffending passengers.

It is reassuring to note that the "stray" shots are only occasional.

◆

How many manufacturers have the moral courage to wind up a business that is on the down grade? How many have the power to see when a business has got to the turning point and no longer returns a profit? One of our most successful manufacturers told me that he undertook nothing but that to which he could give his personal attention every day. This principle carried out by one who understands his business cannot fail. When a business ceases to be profitable the proper thing is to meet the inevitable and wind up the business.—*Wade's Fibre and Fabric.*

Well, it seems rather superfluous to wind up a business that has run down. Winding it up starts it going. Better let it stay run down.

◆

Restaurant keepers have long been troubled as to how to get even with their boarders. Josephine Driat, of New York, has got out a patent for them. It consists of a table and stools, both of which run on an endless chain. The diner comes in, takes a seat on a stool, pays his twenty-five cents for a meal, and it is set before him. The table then begins to move and the man moves along with it. It continues to move him along until he gets to the other end of the room, and at this time he is supposed to have finished his meal, for his dishes slide off around a wheel and his stool slides out with him. There is an endless chain of these stools, and the procession of diners and dinners goes on continuously.

◆

The '*City of Paris*' has left the dry dock and is still in dock in Liverpool. She will not likely go into service before January. She will go to Glasgow and take her new machinery aboard there.

THE ENGINEER.

FORTNIGHTLY. - - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - 2.50.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK, AUG. 30, 1890. No. 5.

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DANGER AHEAD.

ANOTHER swift voyage across the Atlantic has been made, this time by the '*Teutonic*,' a vessel which has not hitherto distinguished herself especially, and was not looked upon as the equal of some other ships. Aided by good weather and the undaunted courage and skill of the chief engineer, she made what is claimed to be the fastest voyage on record. This is disputed by many who claim to have full knowledge of the facts. However this may be, the '*Teutonic*' made a quick passage, and it is an evidence of how the engines must have been driven in order to develop the power required. The '*Teutonic's*' engines are smaller in normal capacity by about 3,000 h.p. than the '*City of Paris*',' the hull is about the same size or displacement as the '*City of Paris*',' which has 20,000 h.p. Now in order to make as good time as the '*City of Paris*,' the '*Teutonic*' must have developed the same power, and to do this required an addition of 17 per cent. to the normal horse-power in the ship. This was obtained by driving them at higher speed than they ever were before driven. As for the pressure carried that is not known to the public, but it must have been higher than was usual on the '*Teutonic*.' The credit for the passage, therefore, rests mainly with the chief engineer and his subordinates, but, as usual, not a word is said about these officers. The following is an abstract from the log of the '*Teutonic*':

Date.	*Miles.*
Aug. 8	473
Aug. 9	496
Aug. 10	512
Aug. 11	500
Aug. 12	485
Aug. 13	340
Total	2,806

The average speed throughout the run was 20.17 miles per hour. This is about 18 knots per hour, and is a long way off from 20 knots per hour, which speed was contracted for on the '*City of Paris*' and '*City of New York*.'

The engine room of a fast passenger ocean steamer is bigger than the average dwelling house, and it is just as full of machinery as it can be and give room for attendance. This last is economized to the last inch, and many places are accessible only by crawling. Now, set all this vast fabric in motion, and consider the multifarious duties of the men in charge. There are little "jigging" details that move only a few inches, and there are others that swing through many feet so swiftly that the eye cannot follow them; there are tons of metal in some details, and ounces in others, yet each one must have regular attention and oversight. If the lubrication ceases for a minute only, the safety of the whole fabric is imperilled, for, at the speeds these engines are run, a small detail, by getting dry, can rip the whole valve-motion out. Now turn on 120 degrees of heat into this engine room, as a pleasant atmosphere to work in, sum up all the anxieties, mental strains, and actual bodily labor, men have to undergo as engineers of high-speed passenger vessels, and then consider whether it is not right and proper that they should have some recognition of their part in fast voyages.

It is proper to say here that the most experienced engineers view with apprehension and anxiety the efforts made to develop high power with such enormous engines by driving them at hitherto unprecedented speeds. The strain upon them is very great indeed, and not represented by any formulas or mathematical expressions. The strains from a given pressure can be deduced, but, besides these, there are the incidental and unusual strains that are always occurring, which will one day cause a much more serious disaster than that which happened on the '*City of Paris*.' The responsibility for it will rest upon the directors and managing officers of the company it happens to, for they are the parties who insist upon fast voyages at all hazards. Icebergs in the way, fogs, breakdowns in prospective—none of these things are allowed to weigh against the chances of breaking the record, or the fleeting glory of beating some other ship an hour or so in a six day voyage. It would be interesting to know what use the passengers by the fastest ship made of the hour or two which they gained at so great risk! Engineers are entitled to be heard upon this point, for they are the men who have made such vessels possible. To build high-speed ships the first men consulted are engineers. The marine architect furnishes the hull, we grant; but he depends upon the engineer to furnish the engines to drive her, and if he says he can put the power in that the marine architect demands, the ship is built. After that the engineers come in again to drive her up to her power. Always, the engineer is the man in the gap, for, if the vessel falls short of the speed predicted for her, everything is laid to the fault of the engineer.

In spite of the fact that vessels have crossed the Atlantic at speeds of over 20 miles an hour, still higher velocities are demanded, and wild men are talking of 25 miles per hour. Let them reach 20 knots continuously first, and it will then be in order to talk about 25 miles per hour.

◆

THE SPHERE OF THE EVERYDAY ENGINEER.

IT is not unusual for employes to feel that "anyone can run an engine," for when they go into the engine-rooms the engine is certainly "running," that is to say, it is driving the shafting, whether at great loss or not matters little to some. However this may, there is no question at all that the man in charge is responsible for the profit or loss with which it is run, and he should receive the credit for it when successful. It is too often the case that he is considered only part of the plant, to be suppressed the moment he asserts his rights to recognition as the cause of the economy. Consider the engineer's duties for a moment, and see whether they are not arduous when faithfully carried out! The whole of the system is under his control, and it is one which requires constant thought and attention, not merely to save money, but to prevent actual waste. The engine does not run itself, as many employers imagine; if it was allowed to do so for a few weeks they would soon see the difference between careful attention and none at all. We claim that to operate a steam plant successfully requires the highest order of intelligence. A case in point, which shows whether steam plants run themselves or not, is that of an engineer who said to us recently that by careful attention he saved last year $2,000 in ammonia alone, it being a cold storage warehouse. This year the saving will be $2,800 in ammonia. Now this amounts to a good deal more than the engineer's salary, and it was all done by honest work and attention to duties. Professor Thurston. in a recent article on the steam engine, adverts to this matter and makes a special point of it. He says:

> "The modern high speed engine now seems to have been brought, in its best forms, to so perfect a condition that the range for further improvement is probably very narrow, and the gain still to be made must come slowly and painfully. In regulation and in simplicity of construction, in speed of rotation and in general adaptation to its special work, it is comparatively satisfactory. The further improvement must be in economy of its operation and maintenance."

The last three lines cover the ground fully—further improvement must come from economy of operation and maintenance.

This is wholly the province of the everyday engineer, as we have called him, and in this direction lies his opportunity. If he is of so little importance it is very curious that builders of steam engines which do not come up to the guarantees made for them, immediately fall foul of the engineer, and charge him with incompetency.

◆

RECENTLY built sailing yachts only 40 feet on the water line have shown a speed of $10\frac{7}{15}$ knots per hour. It is a smart steam yacht of the same length that can beat it.

LOOK OUT!

It is exceedingly dangerous to expose men to the fumes of turpentine or volatile fluids of any kind, where there is not an active circulation of air. Not long ago an engineer went into a new cylinder, which had been coated with white lead and tallow to preserve it from rust, and attempted to scrub it off with turpentine and waste. Although the cylinder was open to the air there was no circulation in it, and the man was overcome in a moment.

Here is another instance of the same kind, which lately happened in Philadelphia with fatal results: Three men, with paint pots, crawled into the manholes of three separate boilers to paint the interiors. The boilers are about twenty-five feet long and four feet in diameter. The only openings were the manholes. Their paint pots were filled with a patent preparation, which was to be tried for the first time. They had not been using the new preparation more than ten minutes when they began to feel ill effects from the fumes. One man got out, but he was almost exhausted, gave an alarm, and told his fellow workmen to go to the assistance of the others.

When the men approached the boilers the deadly fumes that issued from the manholes drove them away, and subsequently one of the men was found dead and the other nearly so. This was probably a benzine paint, but it need not be benzine to be dangerous. Turpentine is just as bad, and will suffocate anyone where there is not an active circulation of air.

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HOW IT IS DONE.

At this season publishers are pestered with premium fiends; that is, persons who manufacture rubbish to sell to subscribers of papers, something upon the same plan of tea store "gifts," where the buyer pays fifty cents for twenty-cent tea and has a ten-cent cup and and saucer presented to him as a reward of virtue!

We are not exempt from the attentions of the premium fiend. This is what he wishes us to publish in our paper; he calls it a novel plan to double circulations:

> "Wishing to largely increase the circulation of this paper during the next six months, we have made arrangements with a New York publishing house whereby we are enabled to offer as a premium to our subscribers a set of the works of Charles Dickens, in twelve large and handsome volumes, with a year's subscription to this paper, for a trifle more than our regular subscription price. Our great offer to subscribers eclipses any ever heretofore made. * * *
>
> "The set of Dickens' works which we offer as a premium to subscribers is handsomely printed from entirely new plates, with new type. The twelve volumes contain the following world-famous works, each one of which is published *complete, unchanged and absolutely unabridged.*"

In a private letter this genius says:

> "Almost any one of your present subscribers could influence one other subscription if he chose. If you can offer twenty-five complete novels as a reward for such service, a considerable number of your present subscribers ought to be willing to perform it for you, and they will. The twenty-five novels I will mail you for twenty-five cents, delivering them post-paid in every case to addresses as you send them to me. Please order by the numbers. Any publisher can well afford to pay twenty-five cents to get a new subscriber. Try this plan. It is new, and bound to be a sucess."

That is a cent per copy for a photo-lithographed book, printed on news paper, and bound somehow. This is a sample of the methods employed by bogus papers to boom their circulation.

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ERICSSON.

By the time that our readers receive these lines the last honors will have been paid to the memory of a great engineer. John Ericsson, or all of him that was once mortal will be on his way to his native land. The American people have done honor to themselves in honoring John Ericsson, who did for his adopted country all that one of its sons could have done, and American engineers can feel proud of the public recognition of their profession and the tributes paid to one of the greatest men that ever adorned it. John Ericsson will live, however, chiefly in the memories of the profession. To the public generally he is as little known and honored as John Smith. He had long outlived his day and generation, while his hermit life of late years and total withdrawal from public life and personal assertion, made him unknown to the men of today. Nevertheless he was never more John Ericsson than he was at the time of his death. He had not lost a jot of his enthusiasm. He was at work up to within a few days. He was planning and scheming new works and perfecting the old ones. At 85 years of age he was still an engineer and still a student. He ceased from his labor simply because the machinery of his body was worn past repair. To those who knew Captain Ericsson personally he was a most attractive man; his was indeed a fiery spirit, that brooked no dictation or control, but underneath all was the kindly heart and generous nature which gave with both hands. The public ceremonies of the occasion which has called forth this brief notice have been so well told in the daily press that we need not repeat them here. This brief tribute to the memory of an engineer is respectfully submitted.

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WHERE GOOD MACHINISTS ARE MADE.

In olden times, when a young man went to learn the machinist's trade, he was put into the broom department on the first day, from which he graduated without honor in due course, that is to say, when another apprentice was taken on. In these latter days, however, the apprenticeship system has gone out, and young men are taken in to learn the trade by another method. This last is so well told by a writer, C. R. Tompkins, that we will give it in his own words:

"A few years ago an intelligent looking young man applied for a job in the machine shop as a lathe workman. Upon inquiry it appeared that he had served an apprenticeship of three years in a large, well-known concern, and had worked upon the lathe all the time. Being in want of a lathe workman, and concluding that three years' experience must render him a competent man for ordinary work, he was engaged and turned over to the foreman, and informed that his wages would be fixed after he had worked a few days. Accordingly he was put upon a lathe and given an ordinary job of turning which an expert lathe workman would perform in a couple of hours. After working half a day he succeeded in spoiling it, and the foreman reported at the office that he was 'no good.' Having a curiosity to learn more of this young man's history, the foreman was directed to send him to the office, and upon examination it appeared that he had served his three years' apprenticeship upon the lathe as he had stated before; but it also appeared that during that time he had done nothing but turn governor balls. The fact was, the foreman of that shop had put him upon a lathe especially designed for that purpose, and with a few hours' instruction he had learned to use it without any further trouble of instructing him; and to render him more profitable to his proprietor, he had taken no further trouble to instruct him in anything else. At the expiration of his apprenticeship all he knew of the machine business was what he had learned the first week. The young man, as before stated, was an honest, intelligent young fellow, and anxious to become a workman; and becoming somewhat interested in him, he was again placed in charge of the foreman, not, however, as a journeyman, but simply as an advanced apprentice; and in time he became a first-class lathe workman."

Thus saith Mr. Tompkins, and many of our readers can certify to similar knowledge. The machinist of the sewing machine or reaper factory is a very different man from his brother of the repair shop, or general machine shop, for the reasons given above. He does mere routine work upon certain details; where the business carried on in any works is the mere reproduction of certain shapes, upon machines which require but slight intelligence or oversight from those who attend them, the result is always the same. Where, then, shall we look for the general machinist, the man who is at home or familiar with all classes of machine tools, and good also at bench work? We think he will be brought up in the railway shops of the country, for in them versatility is a guarantee of a steady job.

Locomotive machinists need to be good workmen, and they are, as a rule, superior. Given, a good workman, and an intelligent man, skilled in the use of tools, it takes but a short time for him to become familiar with machine work of any kind.

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The remarks of Dr. Emery in *The Engineer*, concerning the mistake of the builders of the steamship '*Teutonic*,' in depending upon the improved shape of the hull and less power for higher speed, would seem to have been disproved as soon as made; for, before the paper was dated in which these remarks were commented upon, the '*Teutonic*' succeeded in lowering the record to 5 days 19 hours and 5 minutes. "Power, first and last," is one way to get speed; but the builders of the '*Teutonic*' are not alone in thinking that there is a great deal to be done to models yet, albeit good ones were in existence fifty years ago.—*Boston Journal of Commerce.*

Would it be a service to our young friend to tell him that if he thinks himself capable of commenting on his superior's deductions, it would be more modest for him not to? Our young friend has never had a day's experience except as an amateur, but Dr. Emery has had thirty odd years, and he is right in his statements, too, as to power required, for the '*Teutonic*' was driven as she never was before, and had favorable weather to boot. The '*Teutonic*' is the slower ship because she has not power enough; 17,000 h.p. cannot beat 20,000 h.p.

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Mr. W. J. Thompson writes to the *London Engineer* as follows: Although it is quite possible in theory to obtain a volume of air at a very low temperature almost without the expenditure of work, it is not possible to do this if the apparatus is at the same time receiving heat from external sources. If, for example, large quantities of ice are made continuously, the water to be cooled is continuously pouring heat into the apparatus, and this has to be abstracted by the expenditure of energy. It is one thing to reduce the temperature of a volume of air at one pressure for once, so to speak, and quite another to reduce it after compression if it has received heat at a lower pressure. The practical bearing of the matter is that the work required to be expended will be measured not only by the temperature of the condensing water, but by the heat which leaks into the apparatus from the outside, and too much care cannot be expanded to reduce this to a minimum. Cold storage is a very different thing from the production of ice.

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A gentleman living at Seattle, Wash., has invented an arrangement for driving cattle from railway tracks which is described as a kind of squirt gun. A nozzle is attached to the front end of a locomotive boiler, with a handle leading to the cab. Through this nozzle a stream of hot water and steam is thrown, and by means of a handle the runner can direct the stream toward any part of the track in front of the locomotive.—*Unknown.*

Dear sir, the trouble lies not in the rear end of the ox, but in his front end. Scalding him behind simply makes him kick, and he keeps right on the track. The only way to get a beast off the track is to step down and out of the cab and tell him he is an annoyance. Then he gets right off.

Foreign and Domestic Trade Literature.

THE NEW LIGHT ON HATTERAS.

THE new lighthouse on Hatteras Shoal is a costly structure and an engineering work of great magnitude. It is to be erected by Anderson & Barr, of Jersey City, at a cost of $485,000. The focal plane of the light is 150 feet above the water, and the foundation is to be 100 feet deep.

The firm describe their structure as folfows:

"The foundation caisson is of cast-iron plates, with a bottom section of wrought steel. The total height is 155.5 feet. The wrought steel bottom section is cylindrical, 54 feet diameter and 30 feet high. On top of this is bolted a cast-iron conical section 20 feet high—54 feet lower and 45 feet upper diameter. On top of this is the main body, which is of cylindrical form and 45 feet diameter, and which continues of even shape to the level of the base of the tower.

"Through the whole body of the caisson, parallel with its axis, pass four water-tight steel cylinders 9 feet diameter, through which the ground is excavated from under the caisson. Thus, for 2 feet 9 inches height, the bottom of the caisson consists of a single thickness of cylindrical outside plates and bulkheads consisting of a single thickness of plate, which divide the area of the circle into four equal parts, each of which is provided centrally over it with an open vertical tube 9 feet diameter, for the purpose of dredging its quarter compartment. The bottom circle of cylinder plates 6 feet high is of three-quarter inch thickness.

"The cross bulkhead plates are $\frac{5}{8}$ thick. These central straight plates, as well as the outside circle plates, are provided with stiffening brackets of $\frac{5}{8}$ thickness and 4 inch angle irons. All the other plate of the wrought bottom section is of $\frac{1}{2}$ inch thickness, both the outside cylinder and the interior cones and tube ends. Four-inch angle irons, running vertically the whole length of the section, and 4 feet apart, are rivetted to the interior of the cylinder, and corresponding ones to the conical bottoms, and the dredging tubes are braced together by 4-inch angle irons, bracing in such form as to generally stiffen the structure against both outside and inside strains. Similar angle irons brace those portions of cones and dredging tubes together which face one another. The top of the wrought section is provided with a 6-inch angle iron on the inside of the cylinder, to which the cast-iron cone is bolted This cone, as well as the cylindrical portion of 45 feet diameter above the cone, consists of cast-iron plates of 1$\frac{1}{2}$ inches thickness, and of such horizontal length as to make the circumference of 20 plates 5 feet high.

"The plates are provided with planed hangers forming 6 inch depth of joint all around them, strongly bolted together with 1 inch bolts and nuts, and laid so that the vertical seams of different layers break joints. Lugs are cast on the plates from which 4-inch angle iron braces run to the nearest of the four central tubes. These latter are of a uniform diameter of 9 feet, made of one-quarter inch plate in sections 5 feet high, like the outside plates, and provided on top and bottom with 4 inch angle iron outside rims for joining them by means of 1 inch bolts and nuts. The braces from the cast iron circumference plates are attached to these rims; also braces by which the tubes are braced to one another. For convenience of transportation and erection the cylinders are in halves, joined by 4 in. angle irons and 1-in. bolts on the vertical seams. These tubes extend up to 2 ft. above the high water line, and above that point the circumference plates are braced by turnbuckle bolts of 1$\frac{1}{4}$ in. diameter.

"The whole interior of the caisson, including the tubes, will be filled with cement concrete, except that seven cylindrical vaults will be built in the floor of the tower. On the top surface of the concrete a cast-iron base of 42$\frac{1}{2}$ feet outside diameter and 2 feet width, and 1$\frac{3}{4}$ inches thickness, will be placed, on which the tower will be erected.

"The tower is of slightly bell-shaped form, 40$\frac{1}{2}$ feet diameter at bottom and 19 feet diameter at top, below the main gallery prescribed. It is constructed of cast-iron plates varying in thickness from $\frac{7}{8}$ of an inch for the bottom course to 9-16 of an inch in the top course, provided with ample flanges and brackets for fastening the plates together and for receiving the iron floor beams. The bottom course of the tower is provided with a well-bracketed flange, which is bolted to the base ring, and through which also passes a number of anchor bolts with plates at their lower ends in the concrete long enough to receive the effect of the weight of the brick lining of the tower. All the floor beams are of wrought iron. Those forming the second and third floors are supported by two columns and a stringer beam. These floors are formed of brick arches. The upper floors are formed of hollow floor brick.

MAKING BAD WEATHER OF IT.

EVERYBODY who has been to sea in a steamer knows what to be rolled about is like, and there were moments when our tumblefication was fit to put a nightmare into the slumber of an angel. "It's always like this at dinner time!" yelled the head steward to me, as half the furniture of the dinner tables tumbled away in an awful clattering, made more hideous yet by masses of spoons and forks launching themselves in volleys into an immense basket lined with tin. "It's all the man at the wheel's doing. He's relieved at six o'clock, and the chap who follows him lets her fall off or come to, and here's the consequence!" and he cast a distracted eye upon the saloon floor, where six or eight waiters were crawling about on their hands and feet, picking up fruit, salt-cellars, cruet-stands, napkin-rings, fragments of tumblers, and so forth.

But I am afraid it was not the man at the wheel. It was the sea. Nobody slept that night for having to hold on in bed. I lay in my bunk watching a long succession of contests of speed between a portmanteau and a chair. In the space outside, a table broke away, danced into a married couple's berth, sweeping through the curtain to the consternation of the inmates, pirouetted out again, waltzed into the adjacent cabin, also occupied by a married couple, tumbled headlong over the coaming, rolled to where I had put my shoes to be cleaned in the morning, got mixed up with them somehow, and literally bolted with them into the saloon. Never in all the days of table-turning did any table exhibit such absurd spirits or behave with more impropriety. Some of the passengers fell out of their fore-and-aft bunks so repeatedly that they gave up the job of holding on, and put their mattresses down on the deck. But this did not help them very much, for the heel of the ship was often so great that they would roll from one side of the cabin to the other like casks. Eating became a fine art. By the utmost skill only could a mouthful be had, for the instant the waiter put a plate of food before you it would either discharge its contents over the side of the fiddle into the middle of the table, or airily skim abreast of the neighbor on your left, who had no time to catch it before it had mingled its contents with those of the plate firmly grasped by the neighbor on your right. The seas came along to the ship in processions of cliffs. We were very light, and from the rail of the quarter-deck we showed a side of, I dare say, twenty-three feet; yet when the steamer rolled to windward the oncoming surge looked to rear its foaming head to high above the hurricane-deck, and it was with a positive emotion of wonder that you marked the sweep of the ship up the thunderous liquid acclivity, and not until she hung a moment on a level keel upon the summit of a great billow could you realize that she had hoisted her vast bulk clear of the threat of the arching, glittering green crest which you were just now staring up at.

In the very thick of this weather a steamer bound south passed us. It blew so hard that a man could not look to windward for a few moments without turning his back. The vessel was probably of one thousand five hundred tons' register; she had no bulwarks, and the seas tumbled over and off her in such prodigious heaps of foam that, but for her funnel and spars, you would have taken her to be the head of a rock rather than a buoyant ship. Buoyant do I call her? I don't think buoyancy ever tumbled about as she did. Had her hatchway been open when she rolled her deck to us you would have seen her keelson, or whatever takes the place of that fitting in the ocean tramp; and when she heeled over to windward you watched to see her keel rise clear of the smother. It gave one an idea of the power and volume of that sea to make the steamer's disappearance in the trough, and the wild delivery of the whole fabric of her to the flying thickness overhead when the billow hove her up as though Daddy Neptune's trident had speared her bilge, and the weedy old god was forking her on high, that the spirit of the gale might inspect the sort of ship one is nowadays sent to fight the elements in. She vanished in a haze of spume, and I turned my eyes from the direction in which she had disappeared, wishing from the bottom of my soul that the men who send such structures as she, so loaded, to sea, were compelled by law to sail in them.—*W. Clark Russell.*

GUNS FOR COAST DEFENSE.

THE recently published War Department report that over one thousand modern high-powered guns will be necessary to the proper protection of the American coast indicates in a measure the calls that will soon be made upon Congress for coast defense purposes. The principle of coast defense established many years ago in this country is in the main strictly adhered to by military men of the present day. Though many forts fell during the civil war before the attacks of Federal fleets, the reason may be attributed to an improper defense of the besieged place. Inasmuch as the War Department intends to make our coast defenses a system of earthen batteries mounted with high-powered ordnance, the question of coast defense resolves itself, with us, into providing ourselves with the proper ordnance. It has been estimated by the engineer officers of the army that $60,000,000 will be needed to fortify and arm all the harbors of importance on the coast, and that $25,000,000 will be needed for the heavy guns and emplacements necessary for a defense of New York, Philadelphia, Boston and Baltimore.

In order to insure the construction of the guns needed, it has become absolutely necessary for Congress to not only appropriate a large sum of money for immediate purposes, but one that shall be a permanent appropriation. In this way the object may be achieved of keeping the private manufactories of the country up to a state of efficiency, for it does not appear the policy of the Government to establish gun foundries, wherein the work will be performed wholly by Government officials, but rather gun factories where the heavy forgings may be received from private establishments, then worked over in the Government factory, and the machined parts of the gun assembled. In this way it is hoped to create a sort of dependency of the Government on the country.

It is pretty definitely settled now what type of gun will be adopted by the War Department for general coast defense purposes. This has long been a vexed question, not only with army boards, but with navy boards. To the average man in commercial life the matter of buying the best type of gun would appear at first thought a comparatively easy one. The business man would at once suggest going into the open market and bidding for the best material. But in the matter of guns there are hosts of inventors who claim that their patent is by far superior to any in service, and where there is any shadow of pretension to merit it becomes mandatory on the part of the ordnance people to give the new idea a thorough inspection, and often a long series of tests. In the case of the navy ordnance rifle now adopted for war ships, the type of gun was only settled upon when a board of bureau chiefs decided to plan a gun from the best designs that experience and research would enable them to combine in one piece.—*N. Y. Times.*

STEEL.

THE amount of carbon taken up by iron in order to form blister steel varies from ½ to 1½ per cent. The former would give a steel which would be known as a "spring heat," while the latter would form a "melting heat." The carbon is taken up by the surface of the iron bars and penetrates further towards the centre, according to the length of time and method of treatment. In a "spring heat" the interior part remains iron, although it is changed in character. In a "double-shear heat" the steel and iron are in about equal proportions, whilst a "steel-through heat" is all steel. A "melting heat" is likewise all steel. From blister steel may be made either cast steel or shear steel. The latter consists of bars of blister steel welded together and rolled or drawn down under the hammer. There is single-shear and double-shear steel. The former is generally prepared from blister steel containing about three-quarters per cent. of carbon; whilst the bars for the latter will have about 1 per cent. As in neither case have the bars been subjected to the converting process long enough to make them steel all through, the sheer steel is really composed of a mass of iron and steel mechanically mixed. The double shear steel is twice welded; that is to say, the blister steel bars are welded together, then drawn down to a suitable size, and afterwards welded again and worked down once more. The object of making shear steel is to obtain, so far as may be, the valuable qualities of both iron and steel in one material; namely, the ductility or toughness of iron with the hardness of steel. True cast steel is made from blister steel by melting it in crucibles, known in the trade as "pots." The amount of carbon in the blister steel is regulated according to the description of steel required. The crucibles are placed in furnaces beneath the floor and fired by coke, the fuel surrounding the pots. The bars of blister steel are broken up into small pieces, which are charged into the pots, while in the furnace, through a funnel. The process of conversion has changed the character of the metal in the bars, so that they are easily broken by the hammer. When the pieces of steel have been charged into the pot the lid is put on, and the furnace or melting hole is filled with coke. This part of the process requires the exercise of care and judgment on the part of the men employed. The degree of heat has to be properly adjusted, and also the time the crucible is allowed to remain in the fire. The steel has to be "boiled" in the pot for half an hour or so after it has been melted, a process technically know as "killing." The higher the quality of the steel the more killing has to be done, and it is in this part of the manufacture of cast steel that the superiority of the older methods of preparing steel over the Siemens or Bessemer process is said to chiefly exist. The pots are used three times, after which they are so reduced in thickness that they are useless. The melting occupies from two and a half hours to four or even five hours, the first melting taking the longest time. The charges are reduced as the pots wear, the first being generally about 50 lbs. to 70 lbs., and the third 38 lbs. to 40 lbs., according to the size of the crucibles. The pots are taken from the melting hole, when the process is complete, by tongs; considerable care and experience being necessary so as not to crush the pot, and yet grip it tight enough not to slip. The metal is freed from slag by "skimming," which is done by means of a bar of iron, having some slag attached to this end. This instrument is placed in the molten mass in the crucible, and the slag floating at the surface solidifies around that already on the iron bar. In this way all the slag may be removed, and the molten steel is ready to teem into the ingot moulds. The latter are made in halves, which are held together by iron bands. Such is the process of crucible steel making, roughly described, as now followed at Sheffield. It was introduced into that town a century and a half ago by Huntsman, and so it remains, unaltered, to the present day. In spite of all the advances in metallurgy and chemistry, technical education, learned societies, science colleges, and their army of erudite professors —the Sheffield steelmaker potters along and defies competition. Chemical analysis, which is the sheet anchor of his advanced brothers in the Bessemer and Siemens trade, troubles him but little. His iron comes to him of uniform quality, containing just those elements he requires, and practically free from impurities, so there is no need to analyze that, and the trained eye of the Sheffield operative, perfected by a century and a half of hereditary transmission, will discriminate the amount of carbon shown by the fracture to the tenth part of 1 per cent. Mr. Seebohm tells us that an experienced judge may go to the second place of decimals.

COLLEGE ENGINEERS.

TECHNICAL college education is no new thing in this country. Hundreds of young men have been trained in such colleges. The difficulty is, in certain districts, to meet a young man who has not been in an engineering college of some kind. The superintending engineers of our great steamship lines know as much about steam machinery as perhaps anyone needs to know. It will never be disputed, we think, that the locomotive superintendents of our great railways have practically nothing to learn about locomotives. Can it be said that any one of these gentlemen owes his position to training in a technical college? The face of England is dotted over with works in which the finest machinery in the world is made. Among the managers and foremen of these works, how many can be found who have been blessed with a technical college training? We could extend the list through the whole range of engineering, and it would be found that there is scarcely a single instance in which the man who has been taught engineering in a college has obtained eminence or is earning a good income as an engineer. Tested in this way, the technical college appears in its true character as a fraud and a delusion; and the reason is obvious enough. A body of well-meaning men see that engineers have to deal with the forces of nature, and at once jump to the conclusion that a knowledge of physics is essential to the mechanical engineer. So schools and colleges are started, and the teachers in them are physicists. They spent years in turning out pupils charged to the lips with useless knowledge. We remember a case in which an old and eminent engineer had submitted to him certain examination papers; the answering of the pupils being considered exceedingly good. The old gentleman was delighted, went into the thing thoroughly for an hour or so, and then, beaming with smiles, turned to the head of the college, and, paraphrasing a celebrated statement, said: "This is really magnificent, but it is not engineering." That is, in few words, what may be said of most of the work that has been hitherto done in technical colleges.

For years we have written persistently against a system of instruction which cannot be too strongly condemned. We have had on our side not only the direct utterances of such men as Lord Armstrong, but the tacit inertia of engineers who have said very little, and gone on quietly ignoring the college-trained youth. It is not that he has not been tried. We have had lamentable stories told us, and enough has come under our observation to convince us that the college cannot make an engineer. The opposition we and others have brought to bear is, we are happy to say, at last beginning to bear fruit. Engineers who fill professors' chairs are shaking themselves loose from the trammels which bound them, and are beginning to teach, not physics, but engineering. Engineers are being appointed to professors' chairs, engineer candidates for which, not so long ago, would not have had a remote chance of appointment. A little mote, and the technical college will become an immensely useful institution. Its true function is, as we have already said, to teach young men how to learn to be engineers. The technical college can and ought to give a man very many useful mental tools, and a type of instruction which cannot be got save with much trouble in the shops. But, when all this has been conceded, we fear that the technical college will be found to have lost much of the glory with which it has been foolishly invested. It will descend to a lower level; it will be no longer the happy hunting ground of the highly advanced physicist. Transcendental dynamics will not be talked about within its walls. The good old English foot and inch and pound will turn out the modern jargon of almost infinitely little quantities about which the practical engineer knows nothing, and for which he cares not at all; and so at last the technical college will take its place as a species of school, eminently useful, but making no pretense to turn out engineers. In certain cases college-trained men have done well, not because of their training, but in spite of it.—*London Engineer.*

HOW MARINE ENGINEERS ARE EXAMINED IN MEXICO.

THE following extracts from the letter of an engineer in Mexico, illustrating his experiences, have been forwarded to us for publication, in the belief that they will interest other engineers:

"The Captain of the Port came on board direct by order of the Admiral (second deputy of the Pacific) to investigate matters and demand to see my certificate. He saw it, and then said that before I could sail as chief engineer of a Mexican steamer I must possess a Mexican certificate. Some of the examining authorities being absent in the City of Mexico, a consultation was held, and it was decided, as I held a Board of Trade first-class certificate, and my testimonials were also good, to allow me to proceed on the voyage. A permit was accordingly granted me, and I was informed that I should have to come up for examination at the end of two months. When we got back, however, another of the examining authorities had been called away, and so my permit was extended for a further period of two months. At the expiration of this time I was called up. The delay was very fortunate for me, as the examination was, by law, conducted throughont in the Spanish tongue. The Admiral of the Pacific was my first examiner. He handed me a book in Spanish to read, this comprising the chief qualifications required to pass for third engineer. My performance in this being satisfactory, he asked me if I was prepared to pass for second,also; I replied in the affirmative, and, succeeding here also, he then gave me subjects for chief, or rather the first class, examination. I read the subjects carefully through, and was rather staggered for a moment, as it was the first time I had seen or knew what kind of an examination I was going to pass. The purser spoke Enlish, and, accompanying me, told the Admiral that should there perchance be some question I might not understand, and which possibly he could explain, he was willing to do so; but the Admiral said the law did not permit an interpreter, as it required the use of the Spanish language, and if I did not understand that it was of no use going further. He then turned to me and asked me several questions in Spanish, to which I replied, surprising him a little, and he told the purser he could retire. This took place on board the Admiral's ship (man-of-war) '*Mexico*.' The chief engineer was then called and told to ask me the necessary questions on his part, all the lieutenants and cadets being brought up to hear the examination. He went through much the same verbals as at home· Broken piston, slide-valves, setting-valves, etc., just as though he had been an Englishman. This part of the examination took up an hour. The Admiral, being satisfied, said we should now adjourn to the engine room, and he and five others retired to the depths below, and I had to be chief. The engines being horizontal, I had to go around and name all the connections; the chief broke her up, and I had to repair her to get to port. The chief then declared himself satisfied, and, the Admiral concurring, we once again went on deck. The chief was then told that he was no longer required, and retired, the Admiral giving me several questions in arithmetic and geometry. The worst trouble was still to come, in the shape of the Chief Government Inspector of Schools for the district. He began by giving me mathematical questions quite outside marine engineering, questions I had not seen since leaving school, most of them the same, only in Spanish instead of English. My memory, however, stood me in good stead, and I went at them as they came, feeling myself again. Some of them were stunners, too, because of having to use the metric or decimal system. Then came the drawing, the subject being a crank-shaft suitable for a pair of compound direct acting engines 300 horse-power to a scale of ½ in. to the foot. Of course this occupied some time, but some of the questions had only to be stated correctly; consequently the examination ended at last, and I was informed that I had passed, but that I should have to be photographed in the morning, it being by this time close on 8 P. M. No doubt, too, my examiners, like myself, felt a vacuum of about 28 ins.; anyhow, I went to a hotel, had a big supper and went to bed, to thoroughly prepare myself for the photographic artist in the morning. This trying ordeal being duly performed, three images of myself were pasted on to three (duplicate) certificates, one of them was dispatched to the capital city of Mexico, one is kept at the examining headquarters, and the third is presented to yours truly. Of course, I have not been given it yet, but will get it on my return to Mazatlan, it being signed by the existing President of the Republic himself. Now, you would be surprised if you saw the subjects for the third class certificate. In addition, of course, to the three R's, the candidate has to show himself a good mechanic by filing a piece of brass and iron square and true, use a hammer and chisel, to braize a copper pipe, weld two pieces of iron together, a piece of iron and steel, and do any tinkering job that may be agreed upon by the examiners. You will admit this is a good test for an engineer before he goes to sea. I trust that my experience may be of service to any engineer who thinks of trying his fortune in this very warm quarter of the globe, as, in addition to the climate, the authorities are prepared to give him a reception that may prove quite as sultry as the climate."—*Engineers' Gazette.*

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THE passage from Hong Kong to the Philippine Islands is said to be the worst in the China seas. It is described as a sort of sailing sideways through cross currents into the dreadful typhoon.

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EGYPTIANS made glue 3,300 years ago.

NUISANCES FROM CHEMICAL WORKS.

FACTORIES engaged in any operation that requires the use of chemicals should not be located in populous neighborhoods. Evidence for and against them as injurious to health is easily had.

The Cleveland Board of Health recently heard complaints against the operation of a chemical works in that city on account of being destructive to every form of life and property. The complainants claimed to have lost chickens, suffered ill health, sustained the loss of awnings, eave troughs, sewing machines, tableware, and about everything else. A representative of the company was present to show that the gases were beneficial instead of detrimental.

T. D. Owen, the chemist at the works, said: "The chief product of the works is sulphuric acid. The company buys ore, converts it into gas, and then condenses it into sulphuric acid. I came here from over the water, where there are perhaps the best of works, conducted under very stringent acts of Parliament. It is held there that if a works condenses 95 per cent. of the acid it is very successful, while we condense from 98 to 99 per cent. There is hardly any perceptible escape. I may say that .003 per cent. of muriatic acid in a damp atmosphere will cause a dense fog. The main question is the injury to health. The only authentic evidence on that point is the report of a commission appointed in Belgium, and they declared that the presence of 1, 2, 3, or even 4 per cent. of sulphuric acid gas in the atmosphere was not detrimental to health. Everyone knows that sulphurous acid is a great disinfectant. I have cured children in a moment from severe cases of whooping cough by the aid of the gas. The odor from the gas does not constitute a putrid smell, but a clean smell, if I may use that expression. They are gases that destroy putrid smells."

"What is the effect of gases on vegetation?"

"I never saw such profuse vegetation around a chemical works as we have this year. Between our plant and the Standard Oil Works are the prettiest gardens I ever saw. In this connection it should be taken into consideration that manufactories in this city use hundreds of tons of coal, and that in every 1,000 tons of coal there are thirty tons of sulphur."

"How do you account for the fact that in six weeks a canvas awning became as rotten as wet paper?"

"That is more or less the case in all parts of the city."

"How do you account for the heavy ducts crumbling in a year?"

"I answer that by saying how do we keep iron roofs on a large part of our works?"

"What do you make at the works?"

"Sulphurous acid, sulphuric acid, muriatic acid, nitric acid, sal soda and ammonia."

"Do you say you have done all you can to prevent the escape of gases?"

"Yes; we are making improvements every day," etc., etc.

This is about the usual success the people have when they attempt to suppress what is to them a nuisance. In connection with this subject, we append a paragraph which seems to show that certain gases are very injurious to white fabrics. To wit:

A vessel that had loaded at Liverpool for New York took in a quantity of grain bags and a lot of bleaching powder. While they were not stowed in close proximity to each other, and the ship had the port warden's certificate at the discharging port that the cargo was well and properly stowed, the gases arising from the bleaching powder so injured the grain bags as to render them worthless. The ship being called upon to pay the damage, her owners refused, and exhibited the certificate of good stowage. A suit at law was the result, which was adverse to the vessel, in costs and damages, for several thousand dollars.

AMERICAN RAILROAD PHRASES.

WHEN the traveling American addresses a railway booking clerk in this country in the phrases he uses at home confusion is apt to result, and the two persons often conceive a mean opinion of each other's intelligence. The clerk, misunderstanding the wants of the traveler, professes himself unable to satisfy him, while the latter is irritated that he cannot get a ticket which he sees supplied with the utmost readiness to others. For instance, if a return ticket from London to Dover were wanted, an American, using his accustomed expressions, might possibly demand "an excursion to Dover," when he would be met with the reply that there was no excursion to Dover that day. Varying his words, he might then say that he would take a "round trip to Dover," only to be told with increased emphasis that there were no trips, round or square. Even if he used the phrase "a ticket to Dover and return," he would probably find himself presented both with a single and a return ticket, when he only wanted the latter. The phrase "return to Dover" appears to him absurd, since he cannot return to the place where he has never been. It is undeniable that in this respect our conventional phrase is far from being exact, and it is only custom that reconciles us to its use.

If during the journey the recommendations of the guide book led the traveler to wish to break his journey at Canterbury, he would, if his first experience had not broken his confidence in the intelligence of our railway arrangements, apply to the guard or the ticket collector for a "stop-over." It is to be feared that a worse muddle would then ensue than over the ticket, since the "stop-over" has no existence on our lines. It is a check issued by the conductor, who takes the through ticket, allowing the passenger to stay five days or less at some place *en route.* The names of all the stations on that section of the line are printed on the margin of the check, and that at which the stop is to be made is punched out by the conductor. By this arrangement considerable elasticity is introduced into the system, and the convenience of travelers is studied. When a journey of pleasure is taken, it is customary to purchase a summer tourist ticket, which has coupons attached permitting the passenger to alight at certain interesting spots. These correspond to the circular tickets issued by our own lines for Wales, the Lakes and Scotland, and also to the very complete series of circular tours which can be made on the Continent.

Another curious American railroad phrase is a "stop-over privilege." This gives the privilege to stop at certain points in the route, in contradistinction to a "limited ticket," which compels the purchaser to continue his journey on the train he starts on. Of course, the idea is well known here. On certain long journeys, as, for instance, from London to Aberdeen, the ticket states that the traveler may break his journey at certain towns, and that he must complete the journey in so many days. But we have no general expression to comprehend all this.

The points in which the American system is better than our own are those that result from the conductor being able to go from end to end of the train while it is in motion. This enables the traveler to get his "stop-over" and have his commutation or 1,000 mile ticket punched. Here every ticket for a long distance, say 400 miles, is a "stop-over privilege," and, practically, no ticket is "limited," unless by the last train of the day of issue. The traveler may get out at any station and await the next train. If it is an "open" station he may go out into the town for a few hours and proceed by a later train to his destination. Our season, or contract, tickets, last from three to twelve months, and are available for any number of journeys; often they can be used at all intermediate stations, as well as at the two places marked on their faces. This offers a great advantage over the commutation ticket.

If the railway companies could rely upon the honesty of their customers, it would be possible for them to offer a good many privileges that they are now obliged to withhold because they would be abused. The absurdly small punishments dealt to those who attempt to defraud the companies encourage unscrupulous people to put in practice many mean tricks, the result being that the great body of honest travelers have to suffer for the faults of a few. The close inspection of the conductor in America enables the companies to check many practices that flourish here.—*Engineering.*

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COST OF RUNNING A TWIN-SCREW ACROSS THE ATLANTIC.

The '*Normannia*' is not quite as big as the twin-screw boats of the White Star and Inman lines, but her expense account, owing to the greater length of her voyage, is just as formidable. The cost of running her from Hoboken to Hamburg is about the same as the cost of running the '*City of Paris*' from New York to Liverpool.

When the '*Normannia*' starts on an eastward voyage she carries nearly 3,000 tons of coal in her bunkers,and it costs about $3.50 a ton. The stokers daily shovel into her furnaces between 250 and 300 tons. The expenditure for coal runs just short of $1,000 a day, or nearly $8,000 for the voyage. The cost of the oil used to keep all her engines, dynamos, pumps, and so on, running, combined with the coal bill, is quite $8,500.

The salaries of the ship's company are not an unimportant factor in the expense account. Among the 300 persons who look after the working of the racer and the comfort of her passengers are Capt. Hebich, 8 officers, 1 surgeon, 25 engineers and machinists, 2 pursers, 5 boatswains, 28 seamen, 114 firemen, 65 waiters and waitresses, 22 cooks, bakers and assistants, 2 carpenters, 1 barber, and 14 skilled musicians. The total wages of these for a trip of eight days is about $2,000, not counting perquisites.

Capt. Hebich receives the highest salary. It varies between $3,000 and $4,000 a year, and depends somewhat on the earnings of the ship,of which he receives a small percentage. This is the way the skippers of all the colossal racing craft are paid, and it is not likely that any of them are going to cease racing, or to be censured for it, as long as a fast trip means money in their pockets and in the coffers of their company. Every hour the captain of the '*City of New York*' saves means a saving in coal alone of $50.

Next in importance to the captain of an ocean speeder is the chief engineer. He is not frequently visible to the cabin passengers, and nobody makes much fuss over him, but he is, in the opinion of his employers, a very big man indeed. He is the man who makes the great ship "git up and git." He submits daily reports of how things are going on down below to the captain. He tells how many tons of coal he is using, how much indicated horse-power he obtains, and the number of revolutions the ship's propellers make a minute. If he doesn't get as much speed out of them as the captain thinks he ought to, the captain pats him on the back and tells him to whoop her up, like a good fellow. [That is not the way we do it in this part of the world. The captain does not run the engine room in American steamers. Eds. Engineer.] It is essential to the captain's interest that he should be friendly with the boss of the mighty machines. For his great work the chief engineer receives $160 a month and his board, which is equal to that of the cabin passengers. The chief officer receives $80 a month, which is more than the captains of many steamships of the second-class get. The food and drink consumed by passengers and crew during a recent trip of the '*Normannia*' cost about $16,000.

From the foregoing facts and figures it may be said that one trip of the '*Normannia*' costs the Hamburg-American Line not less than $25,000. To offset this expenditure, which does not include the cost of insurance, the '*Normannia*' must carry many passengers and some freight. The number of her passengers varies, of course, according to the season. She carries in midsummer sometimes nearly 500 first and second cabin and about 300 steerage voyagers. The average price of a first cabin passage is about $110, and that of a second cabin about $60. The average price of steerage accommodations is $22. The receipts from all classes of passengers on a good midsummer trip are over $50,000. Usually the '*Normannia*' carries 800 tons of freight, which at the transportation rate of $10 a ton, amounts to $8,000. The cost of loading and unloading this freight is borne by the company. In the dull season the big twin-screw ships do not make much, but their receipts throughout the year are large enough to warrant the declaration that they are great successes financially, and that they are the passenger ships of the future.—*N. Y. Sun.*

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PUNCHING vs. DRILLING.

Of all the tools that take part in the construction of an iron or steel ship, none are more important, or have more to do, than the machines for punching and shearing, these processes being usually combined in one machine. It is sufficient to say that drilling appliances have not yet appeared that can at all compare with punching apparatus in rapidity and cheapness of working. A good punching machine will make from 40 to 50 holes per minute in a thick steel plate. Where is the drilling machine that will approach that with a single drill? Riveted work requires that the rivets should always be of a diameter in excess of the thickness of the plate riveted. That such is the case is fortunate for the punching machine, for if it were otherwise punching tools would be of little use. The steel punch has not yet been found that will force its way through a cold iron plate of much greater thickness than its own diameter at the speed at which punching has ordinarily to be done. We have known a $\frac{15}{16}$ in. punch, of specially good steel, to perforate an iron plate $1\frac{1}{8}$ in. in thickness, and make a few holes, but no punch could continue to do such work for any length of time with safety. If the punch should crush or double up in a machine with a heave flywheel, revolving at a high velocity, in all likelihood a very serious breakdown of the machine would take place. Happily such small holes, relatively to thickness of plate, are seldom required, and when in rare cases they are, it is always the practice to drill them. The time is perhaps not far off when ship inspectors will insist upon having all the rivet holes drilled. Any such regulation would have the effect of stimulating tool-makers into designing some more rapid and efficient drilling plant than any at present existing.

As to the difference which ought to exist between the diameter of the punch and die hole, that varies a little with the thickness of the plate punched, or ought in all carefully executed work to do so,for it is easy to understand that the die which might give a suitable taper in a $1\frac{1}{4}$ in. plate would give too great a taper in a $\frac{5}{8}$ in. plate. There is no fixed rule. Practical experience determines this in a rough-and-ready way—often in a very rough way indeed, for, if a machine has to punch different thicknesses of plate for the same size of rivets, it is not often the workmen will trouble to change the die with every variation of thickness. It would be easy to draw up a table showing the respective diameters of punch and die for various sizes of holes and thicknesses of plate,but it would be of little use in practice. It would not be attended to; a large assortment of dies would be required; frequent changes of dies involve losses of time which would not be tolerated, and the workmen generally do not consider these relations of die and punch as of much importance. It may be stated, however, that when $1\frac{1}{8}$ in. holes are punched in $\frac{5}{8}$ in. plates, the die ought to be at least $1\frac{1}{4}$ in. in diameter. Usually the die hole is larger.

In connection with this matter, it would be well if foremen, or caretakers of these machines, would more frequently insist upon dies and punches being kept in better condition than they usually are. Any one can understand, that to make a clean, well-defined hole in a plate, with as much ease as possible to the machine, and as little damage as possible to the plate, the cutting edges of both punch and die ought to be sharp, for the action that takes place is really a kind of shear, or ought to be. But how often do we see the die hole and punch with their corners or cutting edges worn quite round? That means a great strain upon the press and upon the steel of the punch, and the hole formed is not cleanly cut out. The piece of metal is really in a manner torn out, and the plate that is treated in this way must suffer deterioration in consequence. The same remark applies to the shears. But these are not usually allowed to go so far wrong, for this simple reason. Blunt and wide-working shear steels give too much trouble to the workmen using them. They tilt up the plate with a rude jerk and give a ragged edge, and this is uncomfortable and inconvenient. The workers find it greatly to their advantage to keep the shear blades in order. Blunt dies or punches do not disturb them so much.—*Engineering.*

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With regard to tests made on boiler plates, ship plates, etc., made of mild steel, no doubt the cold bend test is about the most important, but it should be borne in mind by inspectors of such material that it is also a very unfair test if the edges of such test pieces are simply left as cut by the shears, owing to the crystallisation or hardening of the material all along the sheared edge of the piece, caused by the pressure of the shear blades, which hardening effect causes the piece to break short during the bending test. This more especially applies to the thicker plates from $\frac{3}{4}$ in. upwards, and all test pieces selected for bending should be planed on the edges in order to obtain a satisfactory and fair result, and the pieces bent with a good radius at the commencement, and afterwards flattened down by pressure until the required angle is attained; for by bending it round with a small radius at first, there is not enough space for the compressed metal to occupy on the inner side of the test piece, and the local extension or flow of the metal on the outside is distributed over too short a distance, causing fracture before the desired angle has been reached, whereas with a little care probably the test piece would have given a perfectly satisfactory result.—*Unknown.*

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It has long been questioned whether the ordinary insect powders sold in stores are poisonous to human beings when taken internally. The experiments of two German chemists to determine this point were very thorough. They obtained the active principle, and this is their conclusion: The active principle of pyrethrum flowers (insect powder) is an acid soluble in alcohol. When hypodermically injected into animals it was observed that the poison produced its effects in two distinct stages. In the first there was an excitement more or less pronounced, proportional to the quantity administered; in the second there was a complete prostration, accompanied always by paralysis of the lower extremities, which might disappear after a time, or be the precursor of a fatal issue, the respiration and circulation being affected only in the latter case.

This, be it observed, is the *active principle*, or, in other words, the poison isolated. Taken as sold, insect powder is not poisonous to human beings.

TRADE NOTES.

The Board of Bureau Chiefs in the Navy Department have considered the question of supplying the new cruisers '*Baltimore*' and '*Philadelphia*' with distilling apparatus for the conversion of sea water into fresh water for use in their boilers. All the other new ships in the navy have distillers, but in these two a supply of fresh water is carried in some of the water-tight compartments of their double bottoms, which is the method adopted in the French Navy.

Naval constructors in the United States look with disfavor upon this plan, as the action of the water and air tends to rust out the steel plates.

* * *

The new propeller '*George W. Washburn,*' built by Thomas S. Marvel & Co., of Newburg, N. Y., for the Cornell Steamboat Company, made a very satisfactory trial trip August 3. The new vessel is constructed entirely of steel, and the engine is a compound one of great power. The dimensions of the propeller are: Length, 123 feet; breadth, 26 feet; and depth of hold, 14 feet. Among the people on board during the trip were: S. D. Coykendall, president of the Cornell Steamboat Company; Thomas Marvel, of Newburg, one of the builders of the vessel, and George W. Washburn, the extensive brick manufacturer, in whose honor it was named.

* * *

A second experiment with the Patrick torpedo took place recently at College Point in the presence of the Board of Naval Experts appointed by the Government. The torpedo made nearly one half a knot better time than the terms of the contract required, viz., 20 knots. The torpedo costs about $20,000. It is forty-seven feet long and it weighs more than four tons. The course of the torpedo after it started on its mission of destruction is indicated by two small flags on the long air-tight copper cylinder which keeps the torpedo itself within three feet of the surface of the water. Carbonic acid gas is the motive power. It was under perfect control and hit a target only 25 feet square.

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William J. Hackett, who was for eighteen years an engineer on the lakes, has been appointed chief engineer of the Chicago Northside Cable Department, where he has the control of eight Corliss engines, 4 pair 28" by 60" and 4 pair 24" by 48" of 3,000 h.p. Two new engines will soon be added with 800 h.p. more. Mr. Hackett retired from the lakes four years ago to take charge of the machinery at the Aurora, Illinois, cotton mills, where he remained two years and a half, leaving it with an excellent record to go to California to put in the engine and machinery for the Los Angelos Cable Co. After putting it in he ran it for fifteen months, and left there to take the position he now holds.—*Marine Record.*

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The run which the official train of the delegates to the first annual convention of the International Association of Ticket Agents made from Chicago to Kansas City was a fine performance and, considering the conditions of the run, probably the best ever made in any country. The train consisted of eleven sleeping cars and a baggage car, pulled by two engines, which were relieved four times on the run. The train weighed more than 1,000,000 pounds dead weight, and had besides 350 passengers. A fast run was never before atempted with so heavy a train. The train was scheduled to cover the distance in fourteen and a half hours, but it accomplished the feat in five minutes less than thirteen hours, actual running time, a rate of forty miles an hour.

* * *

Since the death of Capt. Ericsson his executors have brought another bill before Congress for compensation for his plans and labor in constructing the war ship '*Princeton*' in 1884. This boat revolutionized the navies of the world when she was produced. She introduced the screw propeller, and embodied engines placed below the water line, artificial draughts, and many other features then new to war vessels. After she was accepted by the Government, Ericsson put in a bill for $15,000 for his inventions and personal services. It was never formally rejected, but was passed from committee to committee, and finally got stuck somewhere in the War Department archives, after passing both houses of Congress. Ericsson never pressed payment, but his executors have determined to get the principal and the interest due upon it, or to know the reason why it is refused.

* * *

A new lamp for use on shipboard has lately appeared, the most important novelty of which is the lens. Instead of the ordinary lens, a "bent" lens, consisting of two concentric walls of white glass, is introduced. These are so fixed that they form a chamber in which liquid can be hermetically sealed. Glycerine has been used thus far, with coloring matter introduced for the side lights. It is claimed that by the use of glycerine as a medium, 80 per cent. more light passes than is transmitted by glass alone. Tests have proved that with a lamp of this description the red light is clearly visible at a distance of 9,000 yards, or over twice as far as lights are now required to show by the regulations. The flame is circular and the burner is of an improved type, the flame being steady for twenty hours. The red light for use on the port side is supplied with a silvered reflector, and the starboard light has a peacock-blue colored lens and yellow metal reflector, which insures a fine penetrating green light. The lenses are made of plate glass, placed half an inch apart, to contain the colored glycerine, and secured in a copper frame, which fits into an outer frame on the face of the lamp. The glycerine is poured in near the boiling point, and hermetically sealed. A pale yellow glycerine masthead light is proposed, as being of highest service as a signal lamp for marine purposes.

* * *

The recent attempt to coal the cruiser '*Baltimore*' in great haste at New York has impressed the naval authorities with the necessity for devising some method by which naval vessels can be coaled more expeditiously. In order that the coal may afford protection against shot, it is arranged in a large number of separate water-tight compartments along the sides. These compartments are all small and difficult to work in, and some of them are so cramped that the coal can only be passed in by hand in bags. The difficulty is not a new one, but exists to a greater or less degree in all modern so-called coal-protected ships. Naval constructors are giving this difficulty careful attention, and it is probable that in future ships important improvements will be made. It is thought that the bunkers can be so arranged that the coal can be carried into most of them by a system of chutes.

* * *

It is said at the Navy Department that Passed Assistant Engineer Howell, U. S. N., of the '*Baltimore*,' who was in charge of the engines of that vessel when she collided with the '*Dolphin*' at Bar Harbor, has acknowledged that he made a mistake in following the directions from the deck, and turned the engine forward when the signal to back was given. He explains his mistake by saying that he was in the starboard engine room at the time, while he was usually stationed in the port room. The annunciator dial in the starboard room is just the reverse of that in the port room, so that, when a signal to back is given, the pointer in the starboard room is in the same relative position as it is in the port room when a signal to go ahead is given. The signal was given and with a rapid glance at the dial he started the engines forward himself, the machinist who is usually stationed there being engaged somewhere else at the time. Engineer Howell was to appear before a court martial on board the '*Baltimore*' on charges of gross carelessness.

* * *

It is natural to the human race to hop on any one or anything that is down. While that noble specimen of marine architecture, the '*City of Paris*,' is having her broken bones set, and her owners are getting her in condition to, if possible, beat her own best time, the '*Teutonic*,' of a rival company, claims to have beat the great Inman liner's best record *thirteen minutes.* The telegraph operator at the Highlands, and those who timed the '*Teutonic*,' on the other side, however, dissent from the report as taken from this ship's log. It is as easy to cook a ship's log as it is a cutlet, and as the temptation was great on this occasion, we incline to pardon the "shell back" who would do it, but he must not expect the entire marine fraternity to believe the *thirteen minute* yarn. The fast time made by the '*Teutonic*' does not take one jewel from the crown of the '*City of Paris*,' for against the *ex parte* statement of the commander of that vessel, we have the contradiction of official observers on both sides of the ocean. In the meantime there were few barnacles grown on the bottom of the '*City of New York*' in company with the '*Teutonic*,' on this memorable occasion. It was easy to guess that Ernest Gearing, he who broke the six days' record on the '*City of Paris*,' had charge of the '*New York's*' engines. —*Marine Journal.*

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Effort is being made to enlist the lake marine interests in the crusade for subsidies, and thus gain the influence of lake shippers to aid in pushing the Tonnage Subsidy Bill, which has already passed the Senate, through the House. The immense growth of lake commerce in recent years has made the vessel owners a political power, and it is hoped if they can be won for the Subsidy Bill to excite enthusiasm for that job among Western Congressmen. The friends of the Subsidy Bill point out that if it passes the lake marine can in a few years, by means of the St. Lawrence River and the Canadian ship canal system, come under its provisions and thus be greatly benefited. This is a bait to the cupidity of the vessel owners which they have thus far failed to swallow. They do not feel very greatly concerned, for nearly all lake vessels are able at present freight rates, which are lower than for several years, to make a very fair profit on their value. Last year many of the newer steel steamship companies paid 12 and 14 per cent. on their capital, and few boats, and they only the old, worn-out tubs, failed to make 6 and 8 per cent. This, it should be remembered, is on seven months' business. The rates are lower this year than last and profits will not be as large, but they will still be fair. Lake vessel owners are doing well enough now, and have a sure and reasonably profitable business in their control. They know that with the completion of the St. Lawrence canal system competition from ocean-built craft is certain to come, and to so reduce freight rates that a bounty and a chance of running twelve months in the year, will not much, if any, more than compensate them for the losses they will meet and the greater risks imposed.

After a long experiment with patent anchors the Navy Department has decided to return to the old-style anchor. Several new-fangled affairs have been tried, and one, the invention of a naval officer at present on the '*Baltimore*,' obtained quite general adoption. This anchor was recommended by Capt. Schley, then Chief of the Bureau of Equipment and at present Commander of the '*Baltimore*,' with whom then, as now, the inventor was associated. The anchor had been placed on the '*Miantonomah*,' '*Newark*,' '*San Francisco*,' '*Baltimore*,' '*Chicago*,' and other vessels. It is now directed that the patent anchor on these vessels be discarded and replaced by the old-time stock anchor, a change which will cost in each instance nearly $1,000. Admiral Walker, while in Europe on the Chicago, found the anchor unserviceable, and so reported to the department. He purchased the old style anchor, having lost the patented one originally provided for the vessel. The officer will not lose anything, as he has disposed of his patent to an Ohio firm.

* * *

Mr. Stambke, of Berlin, a German engineer, recently gave the results obtained with compound engines by the various State railway boards in Germany. On December 1, 1889, there were running 118 compound locomotives, and 87 were on order. Of the 205, 16 were express, 35 passenger, 139 freight, and 15 tank engines. The Bromberg State Railway Board, employing 74 of these locomotives, reports that the coal consumption averages 12 per cent. less than the ordinary engine. The cost of the compound is about $350 more than of the standard engine, but the cost of repairs is no heavier. The Hanover Board, with 89 compound locomotives, reports that failures in starting are not more numerous with compound than with ordinary locomotives. The steam supply is always ample, and the tractive power is greater than that of the standard. The amount of sparks thrown is less than with the standard locomotive. The Hanover-Cassel traffic office recommends that in future only compound engines should be ordered. The Frankfort-on-Main Board reports a fuel saving of 17 per cent. in the Nordhausen District, and 18 per cent. in the Frankfort. The compound runs steadily at the greatest speed allowed. The Magdeburg Board reports that engines engaged in a variety of work show only 3 to 6 per cent. economy of fuel. The compound freight engines drawing heavy loads long distances show only from 15 to 20 per cent. economy.

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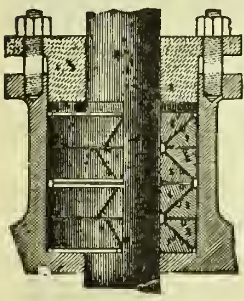

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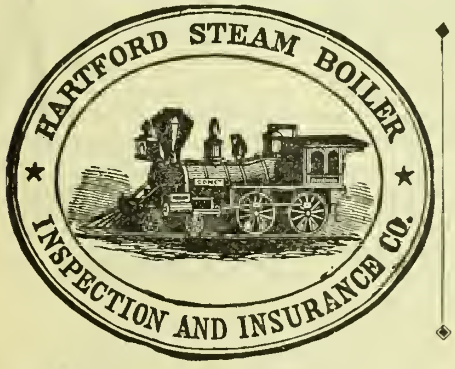

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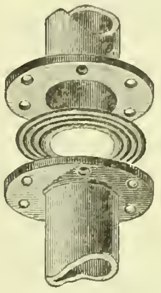

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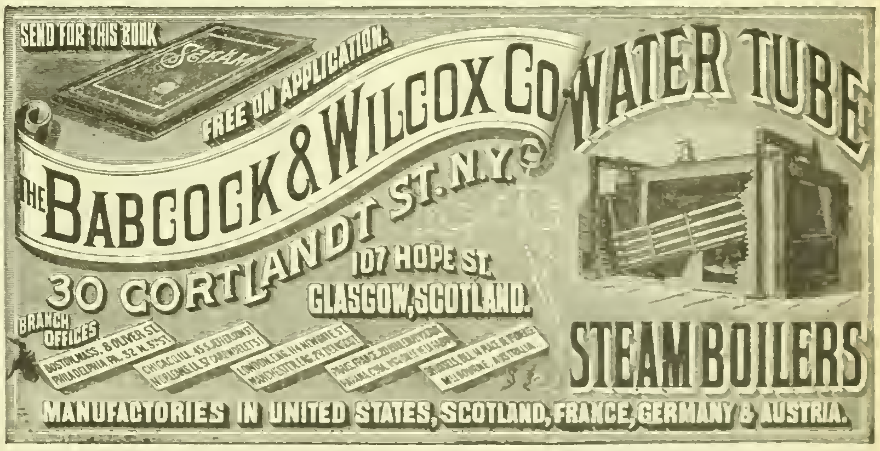
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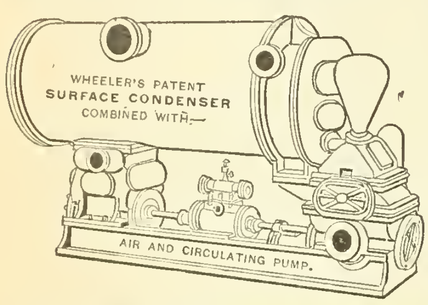
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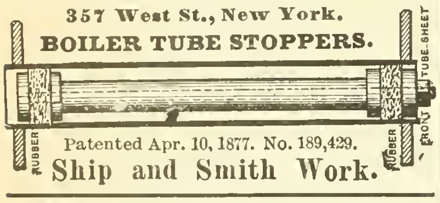

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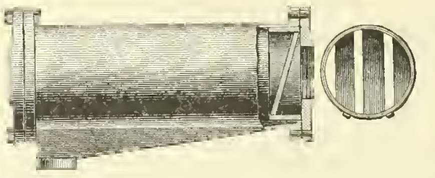

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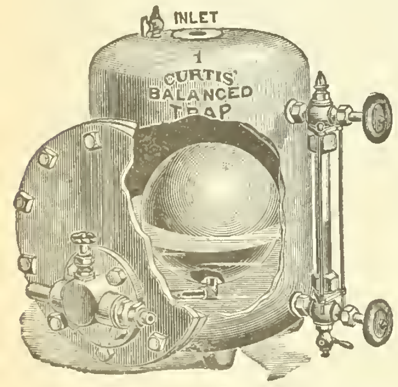

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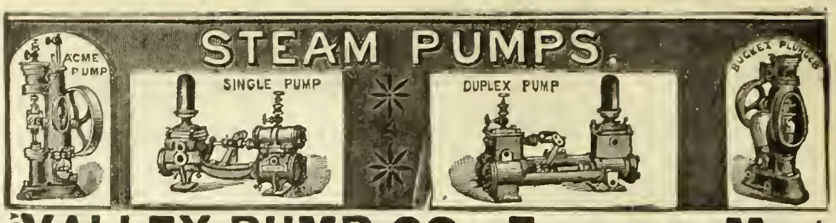

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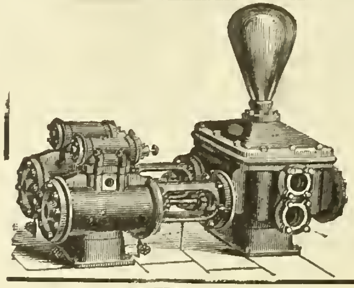

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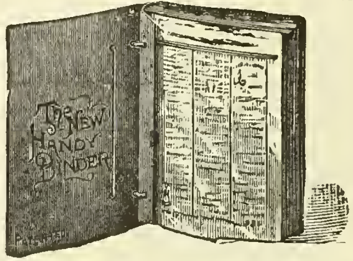

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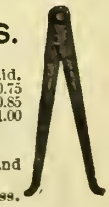

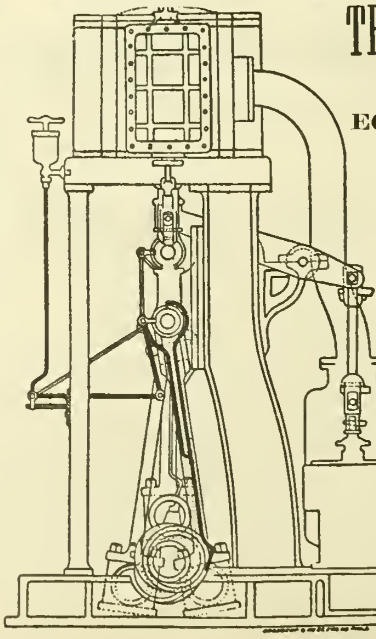

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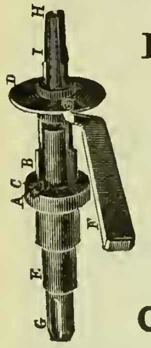

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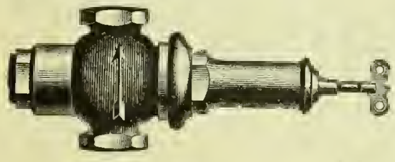

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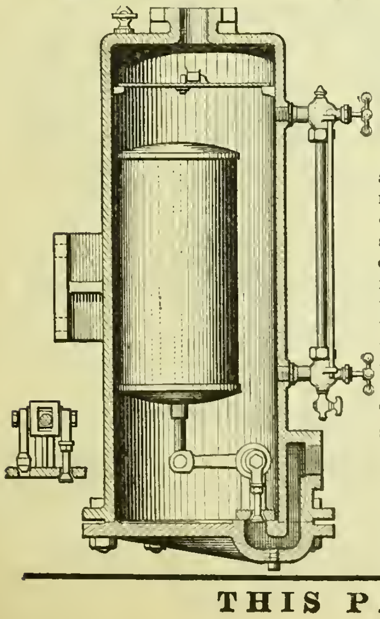

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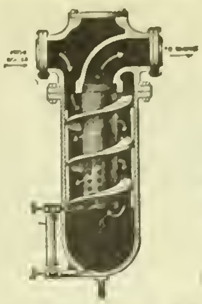

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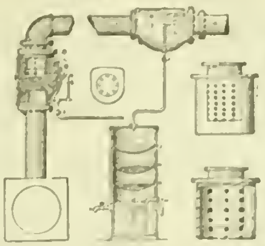

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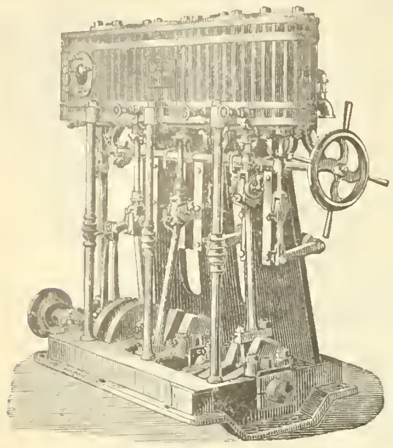

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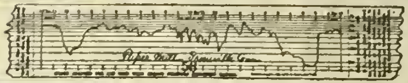

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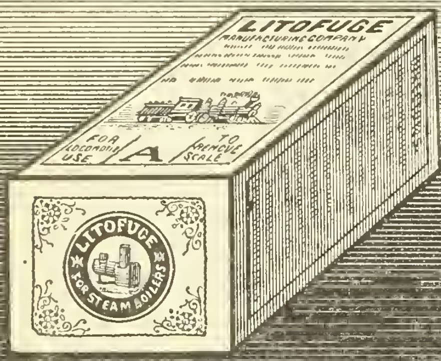

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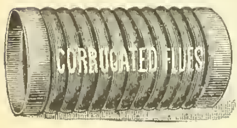

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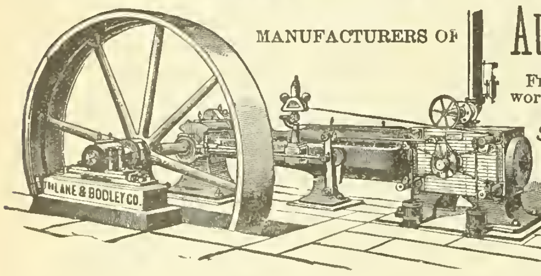
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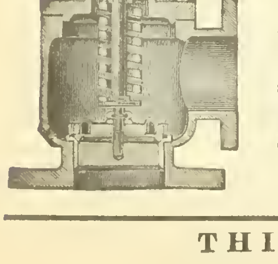

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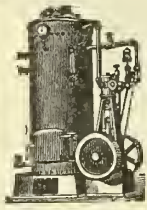

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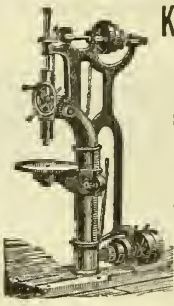

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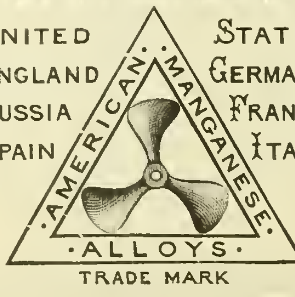

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MECHANICS, AND THE ALLIED ARTS.

ENGINES OF THE 'NORMANNIA.'

THE '*Normannia*' is one of the fastest of the new twin screw racers lately built, and we publish an engraving of her engines, with a description of the same taken from *Engineering:*

This vessel was built by the Fairfield Company for the Hamburg-American Company. The propelling machinery consists of two sets of triple-expansion engines in two separate engine rooms, each set having three inverted cylinders and three cranks. The high-pressure cylinders are 40 in. in diameter, the intermediate pressure cylinders 67 in. in diameter, and the low-pressure cylinders 106 in. in diameter, with a stroke of 5 ft. 6 in. The high-pressure cylinders are fitted with piston valves, and the intermediate and low-pressure cylinders have two piston valves, all worked by the usual link motion valve gear. In each engine room there is a set of air, feed, and bilge pumps worked by independent engines. Each set has three steam cylinders placed above the air pumps and working vertically. Each air pump is 34 in. in diameter, and each steam cylinder 14 in. in diameter; the stroke is 2 ft. There are also in each engine room two centrifugal pumps, driven by independent engines; these pumps are of large size. Besides being used for circulating water through the condensers, they have a connection with the bilge, so that they may be used for pumping out the ship in emergency. In the engine room are also fitted auxiliary condensers, Weir's feed heaters and evaporators, and all modern appliances for economizing fuel and labor. In addition to the usual feed donkey in each engine room there is a similar donkey fitted in each boiler compartment, with the connections to the hot wells, to the sea and ballast tanks. The boilers for supplying steam to the engines are nine in number, 16 ft. in diameter, and 17 ft. 6 in. long. They are of the multitubular type, and are fired from both ends, and have three funnels. Each boiler has eight corrugated furnaces, making a total of 72. The boilers are constructed entirely of steel, and adapted for a working pressure of 160 lbs. per square inch. They are arranged in three groups, with a coal bunker between each group. These coal bunkers are subdivided with a longitudinal water-tight bulkhead.

Each stokehold is fitted with two fans and engines in order to maintain an ample supply of air for the furnaces under all conditions. These fans are driven at a comparatively slow speed.

On the measured mile the maximum speed was 21¼ knots, the engines working up to 95 revolutions. The mean speed on several runs was equal to 20.78 knots, while on a longer trial the rate of speed maintained was 20 knots an hour. On her maiden trip from Southampton to New York the engines were at no time pressed, yet the average speed was 19¼ knots. The guaranteed speed was 19 knots. There is every prospect that the steamer will greatly improve.

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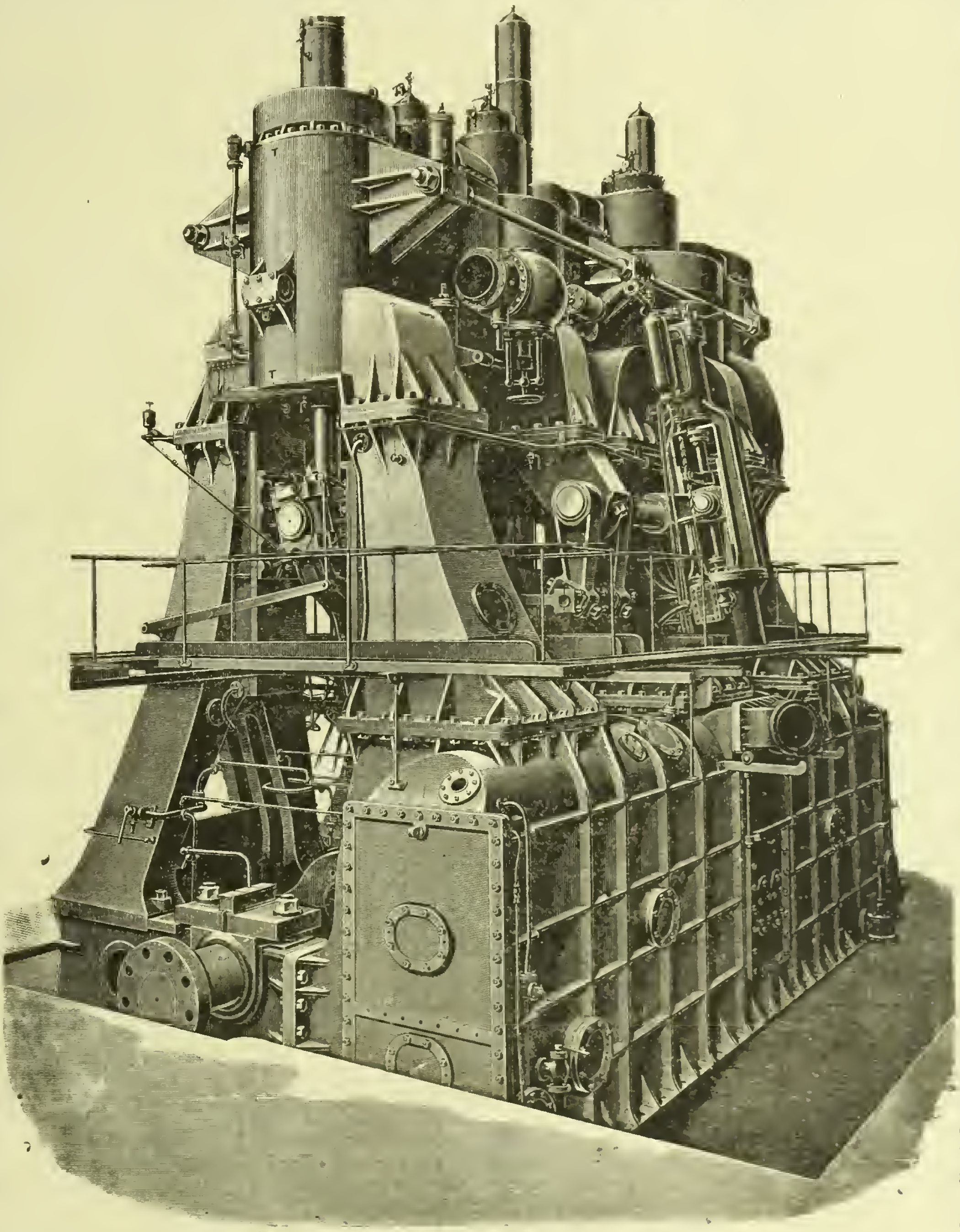


PATTERNS should always be stamped so that if any part is out of its proper place it is easy to ascertain where it belongs. After being returned from the foundry, patterns should be well cleaned, all loose parts fitted in their places so that it can be seen whether everything has been sent back from the foundry, and then stowed away in racks ready for use when required. A foreman will do well to acquire as much knowledge outside his own immediate work as he can, and will find it beneficial; a foreman pattern-maker is looked on as a sort of dictionary, and is often consulted about matters not connected with his own work, both by foremen, mechanics, draughtsmen, and masters. He will find it useful to understand the mixtures of metals, how to calculate weights of castings, and be able to do simple designing, as there are many odd jobs he will be asked to do which are not considered worth while sending to the drawing office.—*Mechanical World.*

SEVERAL of the most prominent and influential citizens of Hartford, Conn., have established the Board of Trade Room and Power Company, and have raised $100,000, this amount having been subscribed by citizens generally. The desire is to establish an experimental station, where the man having an undeveloped idea relating to machinery of any description, but having little money, can obtain for a nominal rental the use of such tools as he may need to enable him to practically demonstrate the good points of his improvement. Should it be thought desirable to place the improvement on the market, an endeavor will be made to obtain the required capital. This work will be done by the members of the company and by members of the board of trade individually, since the company is only formed to foster the mechanical and not the financial part of the scheme. In this way some new industries may be brought to Hartford, and some of the established ones may be benefited. The method of making the first selections, and afterward of patenting and pushing the invention, and of justly treating with the inventor, will be decided upon when the time comes. It is not expected that every idea experimented upon will prove successful, but it is expected that the plan will bring out many ideas of real worth, and that it may produce results of great importance.—*Iron Age.*

◆

THE Supreme Court of Minnesota has lately rendered a decision declaring that bank checks are not cash, and do not possess legal value as money until cashed. In other words, the giving of a check on a bank is not a payment when passed between debtor and creditor, but only becomes so when the money is received on it. This interferes with the schemes of ingenious persons who give checks where they have no deposits.

◆

STEEL changes its size materially after being hardened and fitted to standard gauges, unless permitted to season, as it may be called, so as to eliminate the tensions set up by change of structure in hardening.

◆

ASSISTANT Engineer S. J. McKean, U. S. N., has been ordered to the '*Chicago,*' U. S. N.

SNAP RINGS.

The preponderance of evidence respecting good performance has long been in favor of snap ring packing, so has its cheapness, but people cannot conceive how a simple ring of cast-iron sprung into a groove is to answer for a set of springs, a junk ring and elaborate packing ring outside. The thing does not seem reasonable, and is not, if we assume the same working conditions. Under the old system a piston was carried by its packing, now it is carried on its own faces, and the rings are for packing only. We can remember when precaution was used to prevent the follower or piston plate from touching the cylinder, and also further back when the idea of a cast-iron bearing in a cylinder would have been thought destruction. Things change in these times of ours.—*The Journal, Industry.*

We respectfully assert that the conditions have been universally misapprehended. Also that pistons are generally improperly fitted, or rather made, for they are not fitted at all. For reasons which we do not know, all pistons are made too small; there seems to be an apprehension on the part of some that they will swell up, or expand and stick. There need be no such fear. The piston expands by heat, but so does the cylinder in the same degree. A piston should absolutely fill the cylinder; then very little packing will keep it tight. As for its dragging on the bottom of the cylinder, when in a horizontal engine, that is a small matter if the piston faces are wide enough to do the work. With the sight feed lubricators now in use, the steam is always greased, so that there can be no more trouble in the cylinder than there is on the guide bars. It is well to remember that a piston that fills the cylinder is always central in it, while one that is a quarter of an inch smaller than it either drops down or rests on the packing rings. These last when improperly set out can take five years' wear out of cylinder compared to others properly set out.

We know of snap ring packing in this city in 60″ pistons.

◆

The "pinch fit," so-called, is one of the best devices for securing arms or pulleys on shafts that was ever devised, and it is coming into use very generally wherever it can be employed. To those who are unacquainted with it we will say that the pinch fit is a hub which has two lugs and two bolts on one side. The hub is slotted through to the bore, which is made a sliding fit to the shaft it is to go on. One turn of the set screw, or bolt rather, sets the hub absolutely iron and iron on the shaft, needing no key to make it secure. Slacking the bolts renders it easy to remove the arm without driving or forcing it off.

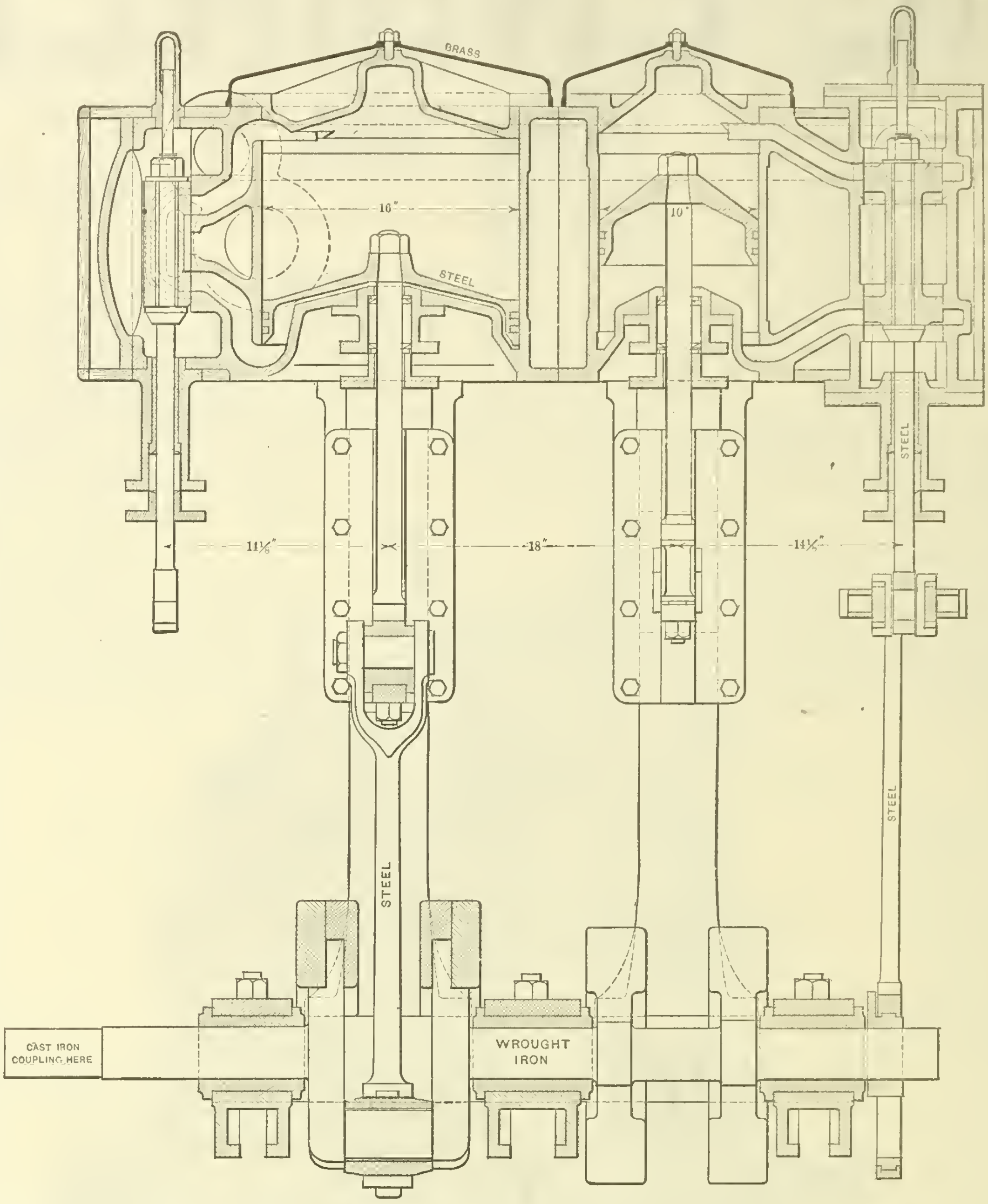
◆

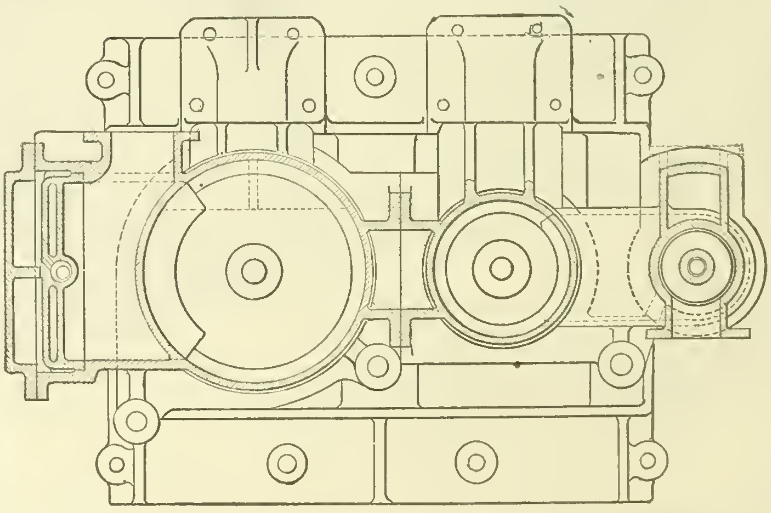
The value of the vessels on the Great Lakes is estimated at $70,000,000 by the *Marine Record*. It seems large to us.

COMPOUND ENGINES FOR STEAM YACHTS.

By the Detroit Dry Dock Works.

The engravings on this and the next page represent the compound engine built by the Dry Dock Works, Detroit, Mich., and designed by Frank E. Kirby. A full view of these engines was given in No. 5, current volume. The scale of these drawings is 3″ to one foot, but persons who intend to use them will find that the engravings are not to scale, as they have been reduced and engraved, which is against accuracy. The engravings are useful, in that they show the general design and arrangement; minor details—in dimension—can readily be supplied by builders.





◆

Brother D. C. Reed, inspector of steam vessels, at the port of Milwaukee, Wis., died at that place in the early part of this month, aged 76 years. Bro. Reed was an esteemed honorary member of M. E. B. A. No. 9, and one of the pioneers in the trade.

The accommodation in the shape of rooms provided for engineers, in the majority of steamers, is a scandal and disgrace. It is bad enough where the present rooms are made for one engineer; but when two men have to live and sleep in a room 6 ft. by 8 ft., it is time the sanitary authorities stepped in, despite the inscription on the room "certified to accommodate two seamen." Another Board of Trade rule—no such thing as engineers. The chief of one of the Atlantic racers is classed as a seaman by the Board of Trade. Let some of our friends, and better still, our enemies, measure off a room 6 ft. by 8 ft.: if that take the berths (these, of course, are one above the other), then a settee, a set of drawers, and an apology for a washstand, and they will find that the space left is about 3 ft. by 6 ft., and this is all the room two men have to move in when in the room together; if a drawer is pulled out, or one wishes to dress, the other must turn into his bunk or leave the room altogether. Nice treatment for the men in whose hands is placed the making of quick passages and economical working of the machinery under their charge. It is surely possible to provide each engineer with a room at least 8 ft. by 8 ft. 6 in., and lighten the laborious work falling to their part by giving them more comfortable quarters to retire to when off watch.—*Engineers' Gazette.*

◆

It is a well-known fact that the stone in an opal ring is very apt to be lost in an unaccountable and mysterious fashion. This arises from the fact that the opal possesses the characteristic of becoming slightly enlarged under the influence of heat. When, therefore, its owner's hand gets hot it is liable to swell and force its setting open to a certain extent. When it grows cold again the gem returns to its original size. This process is repeated until the setting becomes sufficiently enlarged to allow the stone to drop out unnoticed. Another equally practical reason for the ill favor with which opals are regarded is that they are very easily broken, and cannot therefore be looked upon as safe investments.—*Chambers Journal.*

◆

We are always glad to oblige our friends in doing them a service at any time, but we must draw the line at working up indicator cards. This is so easily and readily done by anyone with a little practice, that we must object to spending our time upon them. Very many persons think that an editor has nothing to do but read the papers and look out of the window occasionally, to see how the world is going. If there is any busier man than an editor who attends to his affairs himself we do not know where that man is to be found.

◆

Don't jump into a hole unless there is a chance to jump out of it.

SUPERINTENDENT D. P. LIEBHARDT, of the Post office Dead Letter Department, states that over six million pieces of mail matter reach the Dead Letter Office yearly because of incorrect, illegible or deficient addresses, or insufficient postage. A large proportion of the matter sent to the Dead Letter office fails to be restored to senders because of the absence on wrappers of anything to indicate ownership thereof. Of the letters which reached the Dead Letter office, 42,000 were sent to fictitious addresses, and were principally relating to swindles. Many contained money with orders for the purchase of fraudulent goods. Twenty-eight thousand letters contained money amounting to $48,642, and four thousand others contained postal notes aggregating $5,300. Checks, drafts and notes representing nearly a million and a half of dollars were also received. The remedy, Superintendent Liebhardt says, lies with the senders, and he makes these suggestions: Mail matter should be plainly and correctly addressed, the name of the post-office to which it is to be sent should be clearly and distinctly stated, and the name of the State should be given in full. Street and house number should be given in every case where it is possible to do so, and, in cases where it is known, the place of employment of a person, as well as his residence, should be given. Letters addressed to persons temporarily sojourning in a city where the letter carrier system is in operation should be marked "transient," and the name and address of the sender written or printed on the wrapper.

* * *

AT the Fourteen-Foot bank, off the mouth of the Delaware, there is a lighthouse. This spot is twenty-two miles from land, and its surroundings present no impediment to the waves that curl over it with terrific violence. Even in the summer months the pressure of the waves is very considerable, averaging, perhaps, about 620 pounds per square foot of surface exposed to it. In the winter, however, the average force of the waves, as determined by the marine dynamometer, is said to rise to 2,086 pounds per square foot. Stevenson gives authentic records to show that the force has, in stormy weather off certain localities along the English coast, amounted to no less than 4,335 pounds. When this is properly understood it will not be difficult to understand why the workmen were washed away from the Fourteen-Foot bank. Eleven times their iron cables, several in number and the heaviest that could be bought, were snapped asunder and the scaffolding attached to them was washed away. It was only by the aid of tugs, constantly at hand, that the men thus cast adrift were rescued and great loss of life prevented.

* * *

COMPLAINT about common snap ring cylinder packing is invariably heard where it is put in wrong. Plain snap rings for cylinder packing are the cheapest and handiest packing, and will give good service, if given a show. After turning to within a quarter of an inch of size, and facing the sides, the ring should be cut, and a piece taken out, say one inch long for 18-inch rings, then spring the rings together, and turn the outside true; rings made in this way are round to start with, and have considerable spring or life, and will be tight. Springing rings into the cylinder that have not been trued up after cutting, is a poor plan; the rings never fit.—*Locomotive Engineer.*

* * *

A LAUNCH boiler recently exploded in England, and the cause is shown very plainly. Fracture commenced close to the side of the firedoor, and extended all round the firebox just above the foundation ring. The plates at that part were worn to the thickness of a knife edge by external corrosion, owing to the launch having been partially filled with water from time to time when out of use and exposed to the weather, and to the accumulation of wet ashes in the ashpan when at work.

BRO. WADE, in his *Fibre and Fabric*, says:

"J.——, of Gilbertville, Mass., has accepted a position as second-hand in the card room, etc."

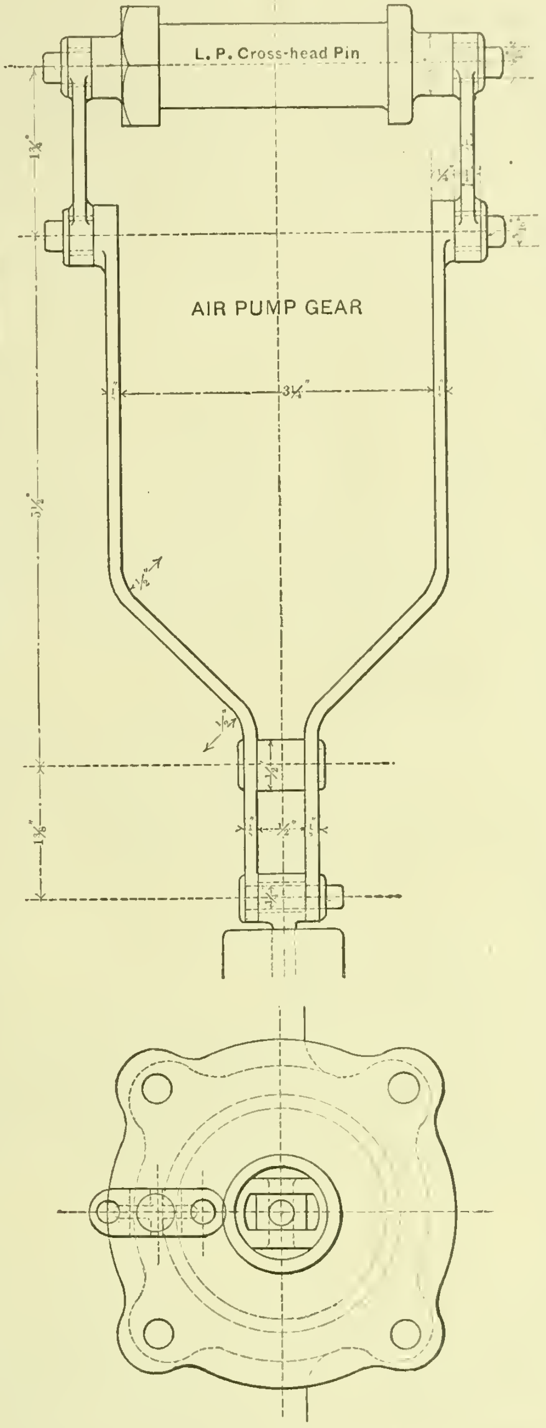
Now, Bro. Wade, you are a reformer, pure and simple, and we want to see you abolish this silly expression for all time. When we were both younger, men were very glad to get jobs, and hunted for them. No one gets a job nowadays, they all "accept positions."

* * *

COMPOUND ENGINE FOR STEAM LAUNCH No. 7.

By the Bureau of Steam Engineering, U. S. N.

THE diagrams herewith show the air pump beam, air pump cover, in plan, and bracket for after end of condenser. Further details will appear in the next issue.



* * *

A FRIEND who means well says:

> "American mechanics, both old and young, are becoming more educated than formerly: and as the young mechanic becomes thoroughly educated, he will look upon his trade, whatever it may be, as just as respectable as that of a clerk or a bookkeeper."

It is singular, is it not, how the occupation of a clerk or a bookkeeper became the standard of respectability—so-called. We have an idea that no handicraft can be reputable or the reverse, but that it is the individual upon whom the stigma rests, if anywhere.

* * *

THE *Marine Record*, of Cleveland, has shed its skin and vastly improved its appearance and make-up. It has our best wishes for its continued prosperity.

COMPLAINTS of the inaccuracy of the census of large cities continue to be made, and there is little doubt but that gross errors have been made. Of course, the Commissioner insists that there are none, but evidence that there are is too strong to be ignored, and in this city there will be a recount. There has already been a partial recount, which shows that there have been serious omissions. These corrections, says Commissioner Porter, will not be accepted officially. "It would be contrary to law to accept figures from any but a duly authorized agent to form a part of the national census," he said. 'The only use to which Mayor Grant's figures could be put would be to use them to correct our schedules. For instance, if a name appears in his returns from a certain street and number, which does not appear on our schedules, that name would be noted, together with any other such that might be found, and a schedule would be sent through Supervisor Murray to the place indicated for the express purpose of securing the omitted names. We could not take Mayor Grant's word, or that of any other unauthorized person, for the existence of the people said to have been omitted without verification through our own officers." As an incorrect census works the greatest mischief to existing death-rate statistics and various interests, it will be seen that "our own officers" will not be allowed to stand in the way of the truth.

* * *

THE engines of the '*Herman Winter*' Ss, Metropolitan Line, N. Y., are finished all over: polished, not mere finish, and they look fit to go on exhibition in the coming World's Fair at Chicago. The cranks, crank-shafts, and main shafts, binders of main bearings, and all nuts and bolts in the couplings, are brightly polished and look as if they had just come out of the shop; they look better in fact, for constant rubbing has made them brighter than the finisher left them. All the brass and copper work shines like so much gold, and there is no place about the ship where a man cannot sit down in his good clothes without soiling them. The engine-room and fire-room are a credit to chief engineer Duncan McIntyre and first assistant E. V. Ballard, and deserve special mention. American engine-rooms on all lines out of this port are clean and in good order, but the '*Herman Winter's* engine-room is the shiniest place we have been in lately.

* * *

AN impression seems to prevail that a diamond will not break if struck with a hammer on an anvil, and more than one fine stone has been shattered in attempted tests, thus proving the fallacy of the assertion. While the diamond is very hard, it is also very brittle, and can be easily broken: and although every substance, from the hardness of feldspar up, including a cleavage or cut diamond, will scratch glass, nothing but the natural edge of a diamond crystal will cut it. If a stone will scratch corundum, and is not scratched by a diamond, it is safe to assume that it is a diamond. It is well to make the trial on a smooth or polished surface, otherwise the scratch will not be perceptible.—*Kunz.*

* * *

"FORMING a company," seems to some a certain guarantee of success in any undertaking, but it is very far from being that. Success depends wholly upon business ability, and is quite independent of the actual value of any invention or enterprise. Of course we mean financial prosperity when we say success, for there are worthless nostrums called medicines put on the market regularly which have no remedial value whatever, but are successes for all that, in the sense that they fill the pockets of the persons who make them. Forming companies is a simple matter so far as the mere incorporation of them is concerned, but the fate of the invention or enterprise, whatever it may be, depends upon the stuff the manager is made of.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

NO SUCTION.

Editors ENGINEER:

Noting an article in the last issue of your paper, I would like to ask if the vacuum created by a pump plunger has any effect in reducing the vacuum in a condenser. Does the air pump add to or take away from the vacuum? Our vacuum is very poor, and I can't make it any better, though there are no air leaks; the foot valves are in A 1 condition, and the joints are all tight. The air pump stands about four feet higher than the bottom of the condenser. I begin to think this is the trouble.

Illinois. SUCKER.

[A condenser with a vacuum in it is a bad thing to pump water out of, if the water has to be raised any distance. There is no atmospheric pressure to push the water up into the pump, and since there is no "suction" to the pump, your condenser probably contains more or less water all the time. This accounts for the poor vacuum. Hot water gives off vapor which destroys the vacuum. You cannot "pump vacuum;" vacuum is a space. You can create a vacuum by pumping the air or vapor out of a closed vessel, leaving the space behind—so to speak; then you have the vacuum in all its glory. The air pump should drain the condenser naturally and not "raise" the water at all.—EDS.]

◆

WEDGES.

Editors ENGINEERS:

Please give me the rule for finding out the power required to raise a weight, or a load, by a wedge. Will two wedges raise a load quicker or easier than one wedge? J. McC.

New York.

[The force required to be exerted on a wedge to lift anything with it is found by multiplying the load (when known) by the thickness of the head of the wedge and dividing the sum by the length of the wedge. Suppose the load is 400 lbs., and the wedge is 2″ on the thick end by 12″ long, then $\frac{400 \times 2}{12} = 66\frac{1}{2}$ pounds to be put on the head of the wedge to raise the load. You can strike a one pound blow with a sledge $66\frac{1}{2}$ times, or two $33\frac{1}{4}$ pound blows, as seems most agreeable. Two wedges will exert more power than one wedge. Each wedge transmits whatever force is applied to it.—EDS.]

◆

NATIONAL MARINE ENGINEERS' BENEFICIAL ASSOCIATION.

To the Order Wherever Found, Greeting:

You are hereby officially informed that District Deputy A. H. T. Simpson has instituted Association No. 82, in Bath, Me., at which time the following officers were chosen and installed: Past-President, Robert Shea; President, C. Gacenback; Vice-President, Herbert Shea; Recording and Corresponding Secretary, Charles Mitchell; Financial Secretary and Treasurer, Frederick Gowell; Chaplain, William Shea; Doorkeeper, Fremont Farnum; Conductor, John Hughes.

Address of corresponding secretary, Chas. Mitchell, Bath, Me.

National President Galwey expresses the desire that each corresponding secretary transmit a letter of congratulations to Association No. 82.

Fraternally, in Unity and Friendship,
JAMES HENRY HARRIS,
National Secretary.
82 Madison Street, Chicago, Ill.

◆

PROFESSOR EDWARD PERRIER lately communicated to the French Academy of Sciences the results of some experiments made by him at the zoological laboratory of the Saint Cloud normal school, upon the use of artificial sea water for the preservation of marine animals, in large aquariums. The solutions employed have been reduced by him to the following formula for from 3 to 4 quarts: Chloride of sodium (common salt) 81 grams, sulphite of magnesia 7 grams, chloride of magnesium 10 grams, chloride of potassium 2 grams. During the exposition this solution gave as good results as natural sea water, with very much less expense. It seems well adopted to baths at home.

◆

WHAT is termed "a popular vote" on any subject is wholly useless if it is intended to show current opinion. If the popular vote is honestly recorded, and not manipulated by persons interested in proving one side of a question, it proves the old maxim in the copy book, "Many men of many minds," for there are about as many on one side as on the other.

THE ARMOR PLATE TRIAL.

THE three plates tried at Annapolis were a Cammell compound, a Schneider all steel, and a Schneider nickel steel, this last having an alloy of about four per cent. nickel with the steel, inasmuch as recent experiments made at Le Creusot have indicated that this combination yields an increase in strength and resisting power. The plates, which were each eight feet high by six feet wide, and ten and a half inches thick, and bolted to similar oak backings, were placed on the arc of a circle about thirty feet from the muzzle of the gun. This was a 6-inch navy breech-loading rifle, a little longer than the pieces now in service, so as to give a higher initial velocity. The projectiles were Holtzer forged steel shells, weighing 100 pounds each; propelled by 44¼ pounds of cocoa powder, they were to have an initial velocity of 2,075 feet per second.

The first shot was delivered against the lower right hand corner of the Schneider all-steel plate, in which the projectile remained embedded, the point having gone a few inches through the steel, leaving only a local injury immediately around the hole. The next projectile, fired at the Cammell plate, passed entirely through it and remained in the oak backing, making several large cracks in the plate, radiating in various directions. The third shot was delivered at the nickel-steel plate, which gave even fewer indications of injury than the all-steel plate, only the point reaching the oak backing. These results were repeated during the subsequent rounds. Stated briefly, the four shots near the corners of each plate left the two Le Creusot plates practically as good as ever, except in circles of two or three inches around the four holes, whereas the Sheffield plate was almost broken up by deep cracks in every direction, and many pieces of steel were scaled off, while the penetrations into the backing had been complete with every projectile fired.

While the report of the Board of Naval Officers of which Rear Admiral Kimberley is president, will be made up only after the final test, which is to be a single shot with the 8-inch gun at the center of the plates, the fate of the Cammell is already determined. It is practically out of the final competition, where the only remaining interest is to see which of the Schneider plates will show the better results under the 8-inch gun with its heavy charge and Firth projectile. The nickel-steel had rather the advantage in the opening stage of the contest, and it only remains to find the result of a heavier attack. But the compound plate is already disposed of, and the Creusot system, which is the one adopted by the Navy Department in its contract with the Bethlehem Iron Company, has certainly won a victory.

◆

ALMOST any kind of a machine will operate a band saw that is in proper order, and no kind of a machine will operate a saw that is not. The teeth must be stiff and obtuse, also thin at the point and sharp. These two things are directly opposed, if we assume that thin pointed teeth must be of the acute hook form to attain a thin edge. This is not necessary. What the teeth want is an obtuse angle, very stiff, and a short hook point "swaged on" and spread at the same time to form the set. Machines are now made for this purpose, and an experienced sawyer when he first sees a saw thus dressed is convinced without an experiment even.—*The Journal, Industry.*

◆

WE find this paragraph in a contemporary:

> "We are informed that the saving in coal by the use of the new engine is from seven to eight dollars per day. A cheap quality of coal is used; with high-priced coal the saving would be even greater."

The average man reads this twice to see if he has read it correctly; then he wonders why the company uses cheap coal at a loss when they know they can use dear coal at a profit.

ROUND PEGS IN SQUARE HOLES.

MR. W. H. PREECE says that one reason for the retardition of electrical progress in England has been that the users of the electric light have been paying heavily for the education and experience of amateur tradesmen and inexperienced contractors, and have neglected to avail themselves of the professional services of the experienced electrical engineer. "People who would not build houses without the architect, nor construct bridges without the engineer, nor make their wills without the lawyer, rush wildly into the use of electricity without any professional assistance, where, above all things, experience and knowledge are essential to prevent disaster and disappointment. Large installations have been completed without specifications to guide the contractor, and without inspection to see that the work has been properly done. The user has paid violently for his temerity, and fires and accidents have been the result.

The same is true of amateur editors upon alleged technical papers. They comment crudely upon the experience of others, not knowing that their speech bewrayeth them in every issue. In one of these papers we find the editor, so called, talking about "bearings for a flywheel," whatever they may be. No one ever saw a flywheel in a bearing of any kind, yet this amateur proceeds to comment upon the matter as though he had had some experience in it. "'Twas ever thus."

◆

A LITTLE experience in life makes it plain that one element of what is called "success" consists in a certain toughness of the conscience. By "success" we mean, of course, worldly success under the present conditions. We do not mean the true and high success, the conduct of one's life in all honesty, with the rewards of a pure fame and the better rewards of conscious clarity of purpose, and fairness of action. We mean that men of business who are trying to live up to an ideal are very apt to find less scrupulous men passing them at certain points, and sometimes permanently outdoing them in the mere race for wealth, from the fact that the latter are less hampered at critical moments by conscientious considerations.

The principle is true in ordinary business; it is true in politics; it is particularly true in the journalistic world. It is a harder task, it requires more genuine ability and greater "staying power," to reap worldly success in this field scrupulously than unscrupulously. The fact is that there is altogether too much reverence for rascals, and for rascally methods, on the part of tolerably decent people. Rascality is picturesque, doubtless, and in fiction it has even its moral uses; but in real life it should have no toleration; and it is, as a matter of fact, seldom accompanied by the ability that it brags.—*The Century.*

◆

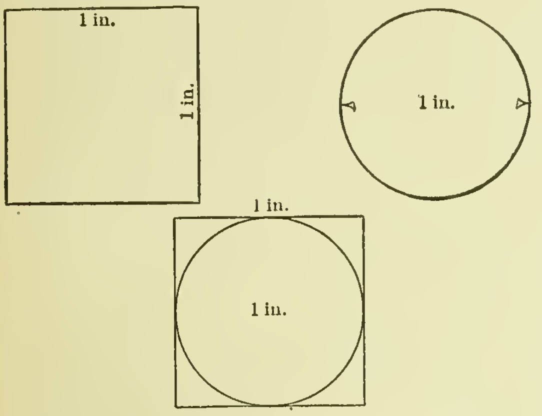
IN the examination of lubricating oils the co-efficient of friction is the proportion which resistance to sliding bears to the force which presses the surfaces together. Many instruments have been devised for this purpose, but notwithstanding the use these instruments have had, my impression is that engineers are far from satisfied with the results obtained, and do not place as much reliance thereupon as formerly. An oil tested upon the tester may show a fine lubricant, while, put under practical working upon a freight car (for instance) would prove vastly inferior. This very often happens, and it has led many engineers to test each oil by a long run, with the particular kind of machinery upon which it is to be used.—*Prof. T. B. Stillman.*

◆

THE strength of the material held in solution in the Chicago River and the canal is best explained by stating that the river water is used by engineers to clean the boilers. The boilers are pumped full when the vessels arrive, and it effectually removes the scales in them. So says an item..

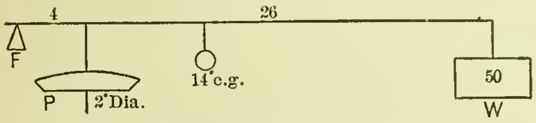
THE SAFETY VALVE AND ITS PRINCIPLES.

To find the upward pressure upon a valve, its diameter being known, we first find the area, that is the whole surface of valve acted upon by steam pressure; to do this we square the diameter, (that is, multiply the diameter by the diameter), or, suppose we have a valve 4 inches in diameter: to find the area we multiply the 4″ by 4″, which gives 16″ square inches. This would be all right if the valve was square or rectangular, but as it is circular it is too great; we must then reduce it to circular inches by multiplying the 16 by the decimal .7854, which gives 12.5664, and this multiplied by the steam pressure gives the total pressure forcing the valve upward. The difference between a square inch and a circular inch is this: a square inch is a square whose sides are one inch, a circular inch is a circle whose diameter is one inch; it can therefore be contained within a square inch; or, the area of a circular inch is .7854 of a square inch.



We should now be able to solve any problem relating to the safety-valve, and will take examples in finding the weight, the pressure, the length of lever, and diameter of valve.

Example First.—What weight should be placed at the end of a safety-valve lever, diameter of valve being 3 inches, weight 3 pounds, 4 inches from the fulcrum. The lever is 30 inches long from the fulcrum, large end weighs 3 pounds, small end 2 pounds, steam pressure is 50 pounds.



Rule.—Multiply the area of the valve by the pressure, and by its distance from the fulcrum multiply the weight of lever by its center of gravity.

Multiply the weight of valve and stem by its center of gravity, or distance from the fulcrum. Add the last two products together and subtract the sum from the first product, and divide the remainder by the length of lever.

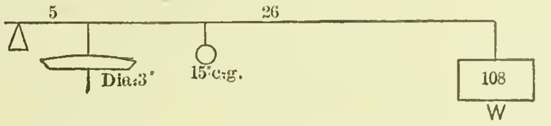
```
                    3″ dia. of valve 5:2::30:12″
                    3                         Center of
                    9                         gravity of
                .7854                    lever from fulcrum.
               7.0686 area of valve.
                   50 lbs.
             353.4300 Total pressure on valve.
                    4″ Dist.from fulcrum.
            1413 7200          5 lbs. weight of lever.
              72.             12 c.g.  3 weights of valve.
            1341.72           60       4 c. g.
                              12      12
                              72
Length of lever=30)1341.72 (44.7 pound=weights of ball.
                   120
                    141
                    120
                     217
                     210
```

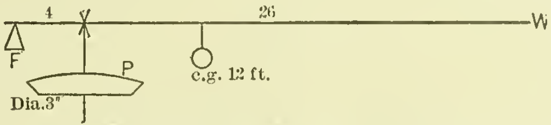
What pressure upon a safety valve will balance a weight of 50 pounds, 30 inches from the fulcrum, diameter of valve 2 inches, weight 3 pounds, 4 inches from the fulcrum. Large end of lever measures 3 inches, small end 2 inches, and weight 7 pounds.

Rule.—Multiply weight of ball by its distance from the fulcrum, multiply weight of lever by its center of gravity; multiply weight of valve and stem by its center of gravity; add all the products together, and divide by the area of valve, multiplied by its distance from the fulcrum.

```
        2×2+3.   7
         2+3=  5) 7
                 1.4
                  10
                14.0=Center of gravity of lever.
Weight of ball   50  Weight of lever  7   Weight of valve 3
Dist for fulcrum 30            c. g. 14             c. g. 4
               1500                  98                  12
                 98    Dia. of valve  2
                 12                   2
               1610                   4
                                  .7854
                                 3.1416  area of valve
12.5664)1610.0000(128.1 pounds        4
        125664          pressure 12.5664
         353360         upon the
         251328         valve.
         1019320
         1005312
          140080
          125664
```

At what distance from the fulcrum must the weight be placed on a safety valve lever, so that the valve will blow off at 100 lbs.? Weight of ball being 100 lbs., diameter of valve, 3 ins., and weight 4 lbs.; center of gravity of the valve, 5 ins. from the fulcrum; center of gravity of lever, 15 ins. from the fulcrum, weight 10 lbs.

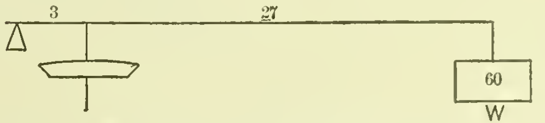




Rule.—Multiply area of valve by the pressure, and by its distance from the fulcrum multiply weight of lever by its distance from the fulcrum, multiply weight of valve and stem by its distance from the fulcrum, add the two last products together, and substract the sum from the first product. Divide the remainder by the weight of the ball.

```
      Dia. of valve  3  Weight of lever 10  Weight of valve  4
                     3        c. g.     15        c. g.      5
                     9                 150                  20
                 .7854                  20
Area of valve   7.0686                 170
Pressure           100
Total press.  706.8600
Dist. from fulcrum   5
             3534.3000   108)3364.3(31.15 inches.
               170            324         Length of lever
             3364.3           124         from fulcrum.
                              108
                               163   31.15
                               108    5
                               550  26.15 inches.
                               540        Length of long
                                          arm of lever.
```

What must be the diameter of a safety valve, the weight on end of lever being 60 lbs., and its distance from the fulcrum 30 in., weight of lever 7 lbs., and its center of gravity 16 in. from the fulcrum, weight of valve 3 lbs., and its center of gravity 3 in. from the fulcrum, pressure of steam 70 lbs.?



Rule.—Multiply weight of ball by its distance from the fulcrum, multiply weight of lever by its distance from the fulcrum, multiply weight of valve by its distance from the fulcrum, add the three products together, and divide the sum by the pressure multiplied by the distance the valve is from the fulcrum, and by the decimal .7844.

```
Weight of ball      60  Weight of valve  7  Weight of valve  3
Dist. from fulcrum  30            c.g.  16            c.g.   3
                  1800                 112                   9
                   112       Pressure,  70
                     9 Dist.from fulcrum, 3
                                      210
                                     7854
                                      840
                                    1050
                                   1680
                                  1470
                                 164.9340
            164.9340)1921.0000(11.64
                     1649340
                      2716600
     Sq.root of       1649340
  11.64(3.4 dia. of valve.  10672600
   9                     9887040
64) 264       .4          7845600
    256       8           6597360
              ⅜
```

W. R.

EXIT THE SPEED TRIAL.

By foreign advices we learn that high-speed forced draught trials of naval vessels are to be abolished in the English navy, and a more rational system introduced. We have always contended that these tests were not only useless for any practical benefit, but that they set up strains which were prejudicial to the life of the machinery. Under stress a cart horse may be induced to a burst of speed, but his natural ability remains the same in spite of his spurt. It is the same with a vessel, and it is very little satisfaction when at sea with a dirty bottom, foul boilers, and leaky engines, to know that the same ship made ten miles an hour more when in holiday trim and apple pie order—whatever this last may be. Our contemporary says:

"The Admiralty authorities have come to the conclusion that the engines of ships of war have an undue proportion of mishaps, and have ordered that periodical trials be made according to the following amended regulations: High-speed trials are to be made once a quarter, each trial to be of not less than twenty-four hours' duration whenever circumstances will permit, with the engines working at from one-half to two-thirds of their specified natural draught. The engines and boilers are not to be pressed beyond this, except in cases of emergency. During each trial the engines are to be run for a period of four hours at their highest speed with natural draught, but the horse-power developed is not to exceed the specified natural draught power. The rate of speed at which ordinary passages are to be made is left to the discretion of the commander and senior officers."

High speed at half to two-thirds natural draught power, would seem to be a misnomer, and is going too far in the other direction. There would seem to be no objection to driving engines up to their full power. It is when they go beyond this that trouble ensues. Any regulation that will abolish high-speed trials, as they are now carried out, would be beneficial to the ships.

◆

We do not assume that boiler insurance companies are infallible; in fact—judging from some results of their work—a few of them have been far from perfect; but, taking in view the wide scope of their business, and the general difficulties they have had to contend with—due largely to indifference and perversity of steam users—we consider that they have done the public excellent service in the past, and are at present capable of doing equally good service in the future. There is one danger, and that is unhealthy competition in procuring business. Competition there will always be, but for the credit of their inspection work, and with the view of extending public confidence in steam engineering, we hope that the leading boiler insurance companies will arrange that competition for new business shall be confined within healthy bounds. Insufficient premiums mean bankruptcy or discredit.—*Industries.*

◆

The sensational accounts of record breaking steamers which appear in the daily papers are merely so much advertising for the line. The public seek the swiftest ships, abandoning the slow as unworthy their patronage; but the slower ships do not give in without a fight, and get up little races among themselves. Then the swiftest of the slow ships sends an account of the run to the daily press, always ending with the announcement that the trip just made was within five or six hours of the fastest ever made. This is called enterprise.

◆

Anyone who feels like despairing because the world has not gone well with him, should try to figure out to what extent the world is to blame for his failure, and to what extent he himself is to blame. If he has not fitted himself for success, it is his own fault that success has not come.

THE ENGINEER.

FORTNIGHTLY. - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK, SEPT. 27, 1890. No. 7.

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BOOKS.

A CORRESPONDENT writes as follows:

"Having had some experience in steam engineering, and wishing to study that branch to a certain extent, I make bold to ask your opinion in regard to the best book or books on that subject."

This is a very simple question to answer, so far as naming a list of works on engineering is concerned. There are innumerable books on the science of steam engineering, which, if carefully studied, will advance young men very much. One of these works is Bourne's *Catechism of the Steam Engine.* It is a very old work, but it is standard of its kind, and whosoever reads it thoroughly will gain much. Another modern work is Hemenway's *Indicator Practice.* Another is Sinclair's *Locomotive Engine Running and Management.* Edwards' *Practical Engineers' Guide* is a useful work; so is the *Cadet Engineer;* so is *King's Notes*—in fact, the list might be so extended as to be a mere catalogue of books. But this is not our object in writing this article. We have it in mind to say something much more useful to our correspondent, and perhaps others may profit by it also. This is, that books are as much tools of an engineer as a file and chisel; and, unless he uses the books understandingly, or intelligently, let us say, he will waste time and money in getting them. It is a fact that too many purchase books with the expectation that the book itself will in some way impart its information without mental exertion of the reader. They take up a work on steam engineering, turn the leaves at random, read casually here and there, and then throw the book aside. It is of no use to waste money in that way. When a young man runs across a passage or a statement that he does not understand, he should not leave it until he does; then he gains something. But if he becomes discouraged at the start, and reads no more because his first essay puzzles him, he will never rise beyond mediocrity.

Look at this illustration—it is wholly akin to the topic discussed. When a young man goes to the shop, for the first few weeks he aches in every joint of his body; he cannot do a job of any kind, but he is not discouraged, because he has determined to learn the trade; he understands that after a while his pains will disappear, and that when he has had time to learn he can do as good work as anyone. It takes time to learn how to read books so as to profit by them, as Mr. Mantallini said of the labor required of him on the mangle: "It is one everlasting demnition grind," but if the grinder is determined to learn he will not mind the labor.

All books are alike in this: there is nothing new to be told. It has all been told many times before. There are no new laws and no new systems in engineering; all is the same as it has been since the world first swung in space and made 365 revolutions and a fraction per annum. But there are new ways of telling old stories, and some authors are happier than others in their treatment. Men who think clearly write clearly, and it is easy to follow their explanations of natural laws. Other men understand their subjects thoroughly but they are not gifted in expressing them, and only weary the reader who tries to follow them.

By all means read standard works, and study them attentively. The information the reader needs is between their covers, but it will not diffuse itself or become impressed upon him because his eyes see it; he must "read, mark, and inwardly digest," if he would learn from books.

◆

SIR CHARLES PALMER says thirty years ago 7.47 men were employed in British steamers per 100 tons, whereas to-day the ratio is 2.88 men per 100 tons. In 1850 the total of steam tonnage owned in Britain was 167,698 tons, and last year 4,717,730 tons.

◆

EVEN the laziest of men usually see some work that some other fellow ought to do.—*Somerville Journal.*

A POINT FOR INVENTORS.

PUTTING an invention on the market is a matter to be undertaken with much circumspection, when it comes to deciding who is to manufacture it. This caution relates more particularly to inventions let out upon a royalty. Suppose John Smith has invented a new candle mould! Naturally he goes to the largest makers of such goods and asks them to put it out for him. They look at it, say it is good, and agree to make it for a certain percentage on the sales, a very liberal one too. The inventor goes home and flatters himself that he has done a good stroke of trade for himself. Then he waits to see his invention on sale. He waits some time, does not see it, hears nothing of it through regular channels, and finally goes to the manufacturers to know the cause of the delay. These gentlemen are very polite. They are very politic, also. They explain things to John Smith, and give him various plausible reasons for not putting it out before. There have been floods in China, and the health of the German emperor is very bad; if it had not been for these and similar unavoidable circumstances, the candle moulds would have been out some time ago, but now the manufacturers have got tired of waiting for the emperor to get well and are going ahead whether or no. John Smith goes home appeased, and takes up his job of waiting where he left it off. He keeps on waiting again, and keeps on hearing nothing, and being unsuspicious, does not know what the trouble is.

Well, we will tell him. The candle mould he invented will conflict with a line of trade that the manufacturers have already established, and will either throw it out entirely or distract buyers. They will have to carry two lines of the same kind of goods, and they are in no haste whatever to put John Smith's mould into the market. They have, in fact, shut him out of it, and locked up his invention without paying a cent for it. Meanwhile, they are secure in their contract with John Smith, for they have not set any time when they will make the goods, and he cannot go to anyone else, because he cannot prove that they are not acting in good faith without tedious litigation.

When contracts are made to manufacture upon royalty there should always be a clause inserted whereby the manufacturers bind themselves to put the goods on sale on or before a certain date, or forfeit the contract. This will prevent any dishonesty of the kind alluded to above.

◆

IN the new Strong Locomotive Works, near Cincinnati, Ohio, it is proposed to mill off surfaces instead of planing them, and thus save a great deal of time. The idea is old as Tubal Cain, and is invented nearly every time an unskilled person sees a planing machine at work. Why not put in five or six tools instead of one, is the question? and it is not easy to answer, although the answer is there if it could be understood. In the first place, milled work is not true. To remove the whole surface down to a finish at one time springs the piece; moreover, the strains are so great that it is nearly impossible to hold work so it will not spring its fastenings. Multiple planing tools set in a rotary disk is an old idea for rough work, such as butting off iron girders or other framing, also for roughing out crank slots. The fact is, that milling processes were long ago applied as far as they are expedient and profitable, as the Strong Co. will probably find out when they come to count the cost. One essential in milling operations is clean, homogeneous material, and this, especially in steel, cannot be expected.—*Industry.*

◆

THE new supervising inspector of steam vessels at Norfolk, Va., is evidently bent upon letting no guilty man escape. In his first decision of an appeal case he finds both captains in the collision of the steamboats '*Virginia*' and '*Louise*' to blame, and takes away both their licenses.—*Marine Journal.*

THE FIRST MONITOR.

Thomas F. Rowland, a well-known engineer and shipbuilder of this city, writes to the New York *Times* as follows:

"In October, 1861, I received a note from Capt. John Ericsson requesting me to call on him. I went to the captain's house as requested. He asked me if I had seen the morning papers. I said: 'Yes. I know you have a contract awarded you by the Secretary of the Navy.'

"'Yes, sir,' he said. 'Now, Tom, what will you charge me per pound to build my iron-clad battery, I furnishing you with all the necessary material?'

"I said: 'I will answer that question at 10 o'clock to-morrow morning.' I was there on time the next day, and stated the price, 7½ cents per pound on all the iron material used. Contracts for the wood work, armor plating, armor backing, etc., were subsequently made at stated sums.

"Capt. Ericsson said: 'Your price is enormous. I know very well it is half a cent per pound too much.'

"'Yes, captain,' said I, 'but you know I am to make extraordinary exertions, working night and day and Sundays if you so order. I therefore think the price named is equitable.' He at once agreed with me, and ordered me to write the contract and insert that price I am particular that this shall be mentioned, because of the fact that stories have been going the rounds that Capt. Ericsson tried to beat me down on my price for building that vessel. I subsequently built four other iron-clad monitors under contract with Capt. Ericsson, and in no one instance did he ever pay me or ask me to accept less than the sum which I named as a fair equivalent of the work to be executed according to the contract. He was, in fact, most liberal and fair in his treatment of the mechanic.

"I soon drew the contract for the building of the iron battery, afterward known as the '*Monitor*,' making myself the party of the first part, and the parties of the second part were Capt. John Ericsson, John A. Griswold of Troy, John F. Winslow of Troy, and Cornelius S. Bushnell of New Haven. The contract was signed by all of these gentlemen except Mr. Bushnell.

"Work was immediately begun, the keel laid, sides erected, and all parts carried on toward completion. Much of the work was done at night and some on Sundays. While the hull was building, the engines, boilers, revolving machinery of the turret, blowing engines, etc., were being constructed by C. H. Delamater of this city, he having had a contract therefor with Capt. Ericsson and associates as mentioned.

"On the 31st of December, 1861, the engines and boilers having been erected in the vessel while on the stocks, steam was applied to the engines, which were fully tested in motion. At 8 o'clock on the morning of Jan. 30, 1862, the vessel was launched. She was of such peculiar construction that many prophecies had been made as to what she would do when put into the water. It was the opinion of most shipbuilders that she would 'throw pitch pole'—that is to say, her stern would go immediately down into the mud at the bottom of the river and she would turn a somersault. But her peculiarities I had provided for by putting air tanks under her stern, and by an automatic device allowing the air to escape and the water to run into those tanks just in proportion as the vessel should be immersed in the water while leaving the ways. She was enabled thereby to slide into the water as quietly as a duck going into a pond to swim. Her decks were scarcely wet. Capt. Ericsson stood at the extreme stern and would certainly have been drowned had the fears of those ancient shipbuilders proved correct.

"One of these, an old man who had built many clipper ships, came over to the yard to see her a few days before the launching, and after studying her fore and aft said to me: 'Young man, I am very sorry for you!'

"'Why?' I asked.

"'Because your boat will 'turn turtle' and go to the bottom of the river.'

"'I wish I had a million,' I answered, 'to bet you that she won't.'

"It was her comparatively shallow hull and long, overhanging deck—much longer at the stern than at the bow, as you can see by the model—which excited the fears of the shipbuilders of that day, and but for the air tanks she would undoubtedly have realized their fears. But I had made my calculations, and was perfectly certain that the device would operate according to my expectations. Besides the automatic contrivance for allowing the air to escape, there was a string for opening the valve wider if necessary, and a man stood ready to pull it, but there was no necessity to touch it. The device operated exactly as I had calculated, and Captain Ericsson told me afterward it was as perfect a bit of scientific provision as he had ever seen.

"The vessel was immediately brought to the dock and the work of completing the erection of her turret and other parts continued without delay. One of the features of the design of this vessel, of which Captain Ericsson was exceedingly proud, was the bare appearance thereof when ready for action. Nothing save the turret with pilot house and flagstaff was to appear upon the decks. The stanchions, smokepipes, and all other movable appliances, were to be stowed below before going into action. The day was set for her trial trip. This, though not in my contract, Captain Ericsson ordered me to superintend. I had the smokepipes set up and everything in readiness to cast off lines and proceed down the bay at one o'clock of a certain day, at which time Captain Ericsson agreed to be on hand. As he stepped from the pier to the boat he said to me:

"'What are those smokepipes up for? Why don't you take them down, sir!'

"I replied: 'We must have them up in order to carry fifty pounds of steam.'

"'Take them down, sir!' he returned, which order I immediately directed to be executed. The lines were cast off, and we proceeded down the East River at the rate of about six knots per hour. We had got below Governor's Island, when it was reported to me from the engine room that we had less than twenty pounds of steam and could get no more. I addressed Captain Ericsson and asked him who was responsible for the safety of the '*Monitor*' on that particular occasion. He replied:

"'You are, sir!'

"'Very well,' I said, 'then up go the smokepipes!' But, unfortunately, he had directed that they be left on the pier at the Continental Iron Works. I had taken the precaution to have a tug within hailing distance of us on the trip. Lieut. Commander, now Admiral Worden, being with us and not very well, I hailed the tug, ordered the captain to set him ashore at Whitehall Street, and then proceed with all posible dispatch to the Continental Iron Works, get the smokepipes, and bring them to us. Before the tug returned to us we were well down the Narrows, and it was dusk when we got the smokepipes in position and began to gain steam. We turned her head toward the navy yard, but for some unaccountable reason, the old pilot, John McGinn, pointed her through the Buttermilk Channel, where we stuck hard and fast on the shoal bottom. However, the tide being flood, we did not have to lie there long. We steamed to the navy yard and dropped anchor about midnight near the Cob Dock, when my connection will the vessel ceased.

"She was taken hold of by the navy yard authorities, fitted with stores, ammunition, etc., and made ready for sea. When she left the navy yard she was to proceed to Washington, there to be inspected by a board of naval officers appointed for that purpose; and fortunate it was she was delayed by the way to fight the '*Merrimac*,' for if she had arrived at her destination, I doubt not she would have been condemned because of inferior workmanship, coarse material, etc., incident to the fact that she had been built in so short a period of time.

"At the time the work was commenced, Capt. Ericsson said to me: 'Tom, you can make all the profit out of this job; I want all the glory.' I replied, 'That is the kind of man I like to work for.' After I had drawn the contract and he had approved it, I said to him: 'Captain, you haven't got any more money than I have. Where is the money to come from for this job?'

"'I will furnish you all the iron you need, sir,' he replied.

"'Yes, but the iron is not all,' I ventured; 'the men will have to be paid their wages.'

"'Well,' said he, 'you go to Troy and ask John A. Griswold if he will furnish you all the money I tell you to ask for.'

"I did not know who John A. Griswold was, and I thought it would be rather a foolish thing to do to go all the way to Troy to ask him such a question, but I did not tell Capt. Ericsson so. I went to an acquaintance in the iron business and ascertained that John A. Griswold was President of the Rensselaer Iron Works and also of the Troy City Bank I asked my friend if he would give me a letter of introduction to him, but he said he could do better. Mr. Griswold was at the Fifth Avenue Hotel, in this city, and he would give me a personal introduction that very afternoon. It was about 5 o'clock when we went there, and Mr. Griswold had just dressed for dinner. I said: 'Mr. Griswold, will you furnish me all the money Capt. Ericsson tells me to ask you for?'

"He flushed up somewhat and said: 'Who are you, anyway? Oh, are you that Greenpoint man? Yes, certainly I will.'

"Mr. Winslow, who is still alive, was also at that time in the iron business at Troy. Mr. Griswold is dead. His son, Chester Griswold, lives in this city and is well known.

"Capt. Ericsson was a very stern, positive man, but he was easy enough to get along with if you did what he told you to do. I always did, and so never had any trouble with him. While the '*Monitor*' was on the stocks he was at my yard every day, and generally all day long, without even going away for lunch. He used to come over in a cab, and while he would always give the cabman money to go and get lunch, he seldom went himself. He said he was going to build a house around the '*Monitor*,' so that she could not be seen, and he did build it, but the vessel was half done before he finished it.

"One day he came into my office and said: 'Rowland, that foreman of yours is a liar.'

"'What's the matter now?' I inquired.

"'Why, he says there isn't a 'winding' or twist of 2½ inches in the deck of that vessel.'

"'Yes, if he says so he is a liar,' I replied. 'For, if you will just wait a minute I will take the instruments out and show you that the 'winding' is 4½ inches instead of 2½.'

"'Well,' he resumed, 'just give him my compliments anyway and tell him he is a liar.' Then he walked out of the office."

◆

It will soon be necessary for teachers of penmanship to either form trusts or strike against the introduction of machines which are killing hand labor in their trade. At the present rate of progress machines are making, it will soon be unnecessary (almost) to know how to write, for the machines are universal. The man who can make dragons, hippogriffs, and all sorts of fabulous beasts with a pen, will be out of a job permanently, and, for our part, we never could see much use or beauty in his handiwork. The typewriter comes next to the sewing machine in utility, and it has aided business in no small degree. Men will not stop to decipher an almost illegible business letter, but the typewritten letter commands attention at once.

Foreign and Domestic Trade Literature.

A BROKEN CRANK SHAFT.

On the Ss. '*Osiris*,' June, 1884, while steaming at usual speed from Algiers to Malta, the crank shaft parted in the middle without warning, and in such a manner as to form a long scarf, extending from the center of No. 2 bearing to the edge of No. 3, cracking both eccentrics in several places and rendering them almost useless.

The engines were compound, with cylinders of 34.5 in. and 64 in. in diameter, with a stroke of 42 in., h.p. 200, diameter crank shaft $11\frac{3}{4}$ in., gross register of ship being 1,879 tons. We made a temporary repair to carry us to Malta.

We patched up the head eccentric with a wrought-iron plate on the sides, the astern one being too bad to do anything with, and secured the astern l.p. eccentric rod to bed-plate, so that we could move the links to center. Having robbed the deck of some strong wrought-iron bands in halves, taken from the spars or derricks, with these we made some fine-thread back-end boiler stays and nuts, and bound the fractured part of shaft firmly together with as many bands as space would permit. After acquainting the captain we were unable to go astern, we proceeded, as no other damage was done. We steamed slow with about 60 lbs. per square inch, gradually increasing the speed until we were running nearly half speed, having had to stop several times to tighten up the bands and lock the nuts, which were inclined to work slack. We duly arrived at Malta entirely without assistance.

Having no spare shaft on board we communicated with the owners, who ordered a spare shaft to be sent out to us by the next steamer.

We now determined to work the l.p. engine, and proceeded thus: Lifted out the disabled crank shaft one-half at a time, and sent it to the Government dockyard, where we had the fractured part on the forward end slotted off and pinned on the aft end, so as to form a solid strong enough to put the shaft in the lathe, and turn it down to $8\frac{3}{4}$ in. diameter for about 2 ft. over the fractured part. Over this was shrunk a wrought-iron ferrule, bored to fit, about $1\frac{1}{2}$ in. thick. This again was turned to fit the eccentric.

This ferrule, as we will term it, was securely pinned on to shaft with $\frac{3}{4}$ in. screws, and on the ferrule we were enabled to key the eccentric, substituting one of the h.p. sheaves for the broken astern one on the l.p. engine, putting them both a little further back from their previous position, in order to cut off a little later on the up and down strokes, lowering the l.p. valve at the same time to suit the required lead. During the time the crank shaft was ashore we removed the h.p. slide-valve, together with its spindle, plugged the hole, and rejointed the h p. steam-chest; also lowered h.p. piston to bottom of cylinder, and secured the connecting rod in a vertical position in the center of crank race, and disconnected the auxiliary starting gear for the h.p. engines. Covers are jointed, steam in readiness for a trial, at first with 30 lbs. of steam in the boiler and gradually increasing it. As all the pumps are worked from the l.p. engine, they were all shut off, as well as the main injection valve, until we found she was under way, when it would be opened, using the donkey for circulation in the meantime.

We could not induce her to turn the top center going ahead, at times coming pretty near it, but not quite high enough, gradually raising steam till we reached 60 lbs. per square inch, trying her all the time, but still unsatisfactory.

We now lifted out l p. slide valve, and chipped off $\frac{3}{16}$ in. of the lap on both top and bottom edges of the valve at an angle of 45 degrees, fitting new feather to eccentrics and setting them further back, lowered the valve to suit proper lead, and tried again, but with very little more success. Lifted out valve again, and chipped away $\frac{1}{4}$ in. exhaust lap, in order to enable her to exhaust earlier, replaced valve, and tried her again, but found not the least benefit, having determined not to carry more than 60 lbs. per square inch on the l.p. cylinder, as our working pressure was 80 lbs. We again lifted out slide valve and chipped off another $\frac{3}{16}$ in. at same angle on top and bottom edge; this made her $\frac{3}{8}$ in. less lap on top and bottom edges of slide valve, fitted new feathers, put sheaves further back, and lowered valves to have $\frac{1}{32}$ in. lead on top and $\frac{15}{16}$ in. on bottom, going ahead; at the same time having had patterns made for lead weights to be cast and bolted to the side of turning wheel, in order to accumulate sufficient inertia on the up stroke to carry the crank over the top center as she would pass the bottom center. Steam ready again for another trial at 30 lbs. pressure per square inch, trying her continually till we reached the limit, 60 lbs. She would now turn the top and bottom centers very well, both ahead and astern, opening the main injection and other valves when properly away. Having gained our point we abandoned the lead weights as proposed. But the steam pressure quickly dropped, as our steam was now cut off rather late in the stroke, both top and bottom, but being able to go ahead and astern when required, we started to Alexandria, with an average speed of 7 knots per hour. In consequence of this result, our owners decided not to send out our new shaft as intended, but to let us steam home with the l.p. engine and fit new shaft on arrival. On our homeward passage we called at Gibraltar for coal, as we noticed a marked difference in the consumption, for the power and speed developed with one engine. Originally burning from 16 to 17 tons of coal per day, developing about 700 h.p., steaming at the rate of about ten knots per hour, this consumption gives a fraction over 2 lbs. of coal per h.p. per hour. Now with the l.p. engine alone developing, say 342.7 h.p., we consumed at least 17 tons per day, or 4.6 lbs. per h.p. per hour, and only steaming a little over 6.8 knots per hour.

This is simply written to illustrate the superior economy of using h.p. steam in a modern triple-expansion over one carrying a low pressure, in the former case consuming about 1.3 to 1.5 lb. per h.p. per hour, and the latter burning about double or more. All we coaxed the fires we could not raise the steam a peg beyond 25 lbs., very frequently less. Of course, this is easily accounted for. —*Engineers' Gazette.*

[This is in no sense a test of the relative values of simple vs. compound engines, although tried with the same engine. The pressures were only 40 lbs. absolute, as against 90 lbs. absolute, and only two expansions with the single l.p. cylinder in use, as against six or more with the compound. What is remarkable, however, is the fact that the l.p. engine required so little coal under the circumstances, hasty valve setting, etc. Four pounds of coal per h.p per hour is very little indeed for the conditions given.—Eds. Engineer.]

We wish those who have had experience with them would tell us whether there is ever any trouble with spring in radial drills, when the drill is used at the extreme end of the arm. Suppose we had to drill a hole 1″ diameter in wrought-iron ten inches deep, would the drill bind at the top of the hole 9″ down? As many radial drills have iron bed plates which extend some distance at the bottom, it would not seem difficult to supply a stay-bolt from the end of the arm to the bed-plate, which would check any tendency to lift in the arm and would not be in the way of the work.

Recent tests of ammonia ice machines showed that 24 pounds of ice were made for one pound of coal, and this could be increased under certain conditions which are too technical for the general reader.

EDUCATION OF ENGINEERS.

The question is continually debated whether the training in the shops should precede or follow the college course. If we ask the opinion of a works manager, he says that the youths he gets from college are fearful prigs, and do no good; they imagine they know everything, and despise all the work they are expected to do. The professor, on the contrary, says that the shop-trained lad is conceited beyond endurance; he regards the refinements of knowledge as foolishness, and has no patience for delicate investigations that do not promise some immediate practical result. It is the old case of Sandford and Merton over again. The former youth, surveying a party of finely-dressed ladies, wondered what they would do if they were cast on a desert island. Similarly the practical boy contemptuously asks what kind of a figure the professor and his class would cut if sent out as a break-down gang on a railway. Tommy Merton declined to give his attention to mechanic arts, and in like manner the collegian cannot imagine that he can learn anything by cleaning out a boiler. We fear those difficulties are irremediable, and will always have to be met. But we are strongly of opinion that there is less difficulty if the shop training comes first. As we have already said, it gives an opportunity of deciding whether there should be any college training at all. That, of itself, is sufficient to cast the balance in favor of this plan. Then, again, it enables the right order of study to be followed; first school, then evening instruction, aided by second-rate teachers, and lastly training by eminent professors. If the college follows the school, the immature mind will not be able to take full advantage of it. Then during the after period of apprenticeship the youth will generally be too advanced for the teachers of evening classes to give him much assistance, and he will thus be left entirely to his own resources.

A still more cogent argument against college preceding the shop is found in the contempt for manual labor which comes to the student. After a boy has been engaged in research, and has learned how to make fine measurements, and how to work out his results with extreme accuracy, he thinks he has nothing to learn from rough workshop practice. The dirt repels him: but more particularly he is dissatisfied with the inconclusiveness of his observations. He has been accustomed to arrive at some definite result with a small margin for experimental errors. But in the shop he cannot codify his knowledge. He sees a certain phenomenon to-day of a kind which cannot be expressed in figures, scarcely in words. It may be months before he finds another example with which to make a comparison, and in the meantime the recollection of the first has grown so dim that much of its value is wasted. Again, in the laboratory he generally knew what to look for, and could reject everything else. But now most that happens around him is on the same level, and there is nothing to focus his attention. He feels that he is not acquiring anything. Day after day passes and he cannot see that he has added to his store of knowledge; he has only progressed one step towards becoming more like a workman, an end that has no interest for him. He does not realize that the conditions of daily life are never those of the laboratory; the problems set him have not hitherto had any factors which can be estimated only by judgment and experience, and he does not know that in his professional career six-sevenths of his work must be done by a kind of unconscious knowledge which resembles instinct. He is, in fact, learning something of which his previous training has rendered him incapable of estimating the value.

We fully admit that the shop-bred boy has also difficulties to face before he can bring himself to appreciate the minutiæ of the laboratory. But if he has carried his scientific education as far as he ought to have done, he has learned that he is very ignorant of much that he ought to know, if he is to attain a high rank in the profession. In every science he has studied he has found himself stopped by his want of knowledge in some other science. He has asked questions in the works which nobody there could answer, and has longed to make experiments for which he had no apparatus. Consequently the laboratory opens up to him fresh opportunities, and whatever contempt he may, in his juvenile conceit, feel for some of its methods, he must know that there is a great deal to be learned in it. * * * *

Given an engineer of strong intellect and self-reliant disposition, a thorough technical training is the richest possession he can acquire. Then ball is then at his feet; he can watch the turn of events, and take advantage of every opening. Science is to him a wand by which he can command the great powers of nature and bend them to his use. Further, it is a means of education which strengthens his brain, just as exercise invigorates his body. It renders every sense alert, quickens his perception, and furnishes him with a hundred clues by which he can advance when he has reached the end of the trodden paths of knowledge. Without it he is in a more or less dependent position; he may command the knowledge of others, but this is a very different thing from having it himself. He has not only the consciousness that he gains an amount of credit which is not his just due, but his power of initiation is shackled. He has to proceed by faith to a certain extent, and possibly his faith may be misplaced. It by no means follows that he cannot attain a high position—a vigorous intellect will insure him that—but he cannot reach the top rung of the ladder. A man of equal natural parts, but better trained, will surpass him.—*Engineering.*

DANGERS OF ELECTRIC LIGHTS ON ENGLISH STEAMERS.

THE fact that the '*Etruria*' on a recent passage was on two occasions threatened with fire has excited comment. That those fires originated in the improper insulation of the electric light wires has given rise to inquiry as to the probability of their recurrence.

The '*Etruria*' is one of a large number of transatlantic steamers whose wires are strung on the English plan. This plan consists of a single wire from the dynamo to the lamp, the current being returned by the the hull of the ship. The frame, which is of steel, serves the purpose of a return circuit. This plan is the cheapest that has been devised, for it requires a short length of wire, a very low weight of copper, and, owing to the great size of the hull, affords practically no resistance in the return circuit.

Following out a theory of economy that one would hardly expect to find on the finest steamships in the world, this system is provided with very few safety plugs. The function of a safety plug in an electric current is the same as that of a safety valve on a steam boiler. When, through any cause, the circuit becomes disorganized, this fuse burns out under the influence of the stronger current. Thus the circuit is interrupted and the danger avoided.

Instead of having a safety fuse for every lamp, as is the case in the American system, the English provide but one fuse for ten, and sometimes fifteen lamps. Thus, when through any cause the insulation becomes imperfect, instead of a prompt cutting off of the current, the leak increases, there is no return circuit wire to afford additional precaution, the wires and their adjoining surfaces become heated, and a fire results. This is precisely what happened on the '*Etruria.*' It is understood that the plant had not been refitted in several years. Doubtless the insulation had been rendered imperfect by mechanical abrasion of some sort. The current naturally leaked across to its powerful return circuit, the hull, and by means of the exposed current thus established, the inflammable adjoining surfaces caught fire.

That this might easily have been avoided, and that the risks to which ocean steamers of the '*Etruria's*' class are subjected might easily be overcome, is seen in a comparison of the English with the American method of stringing wires on shipboard. At best the operation is a delicate one; far more so, in fact, than shore work, for the vapors arising from the salt-laden atmosphere, and the racking to which the framework of the ship is subjected, are causes which militate against the most excellent system of wiring and the highest class of insulation.

The American system of wiring on shipboard is a complete metallic circuit, the return conductor being of wire precisely like the original wire. These two wires are so carefully insulated and so plentifully protected by fuses, that the abrasions and leaks causing the '*Etruria's*' trouble are hardly possible. The copper wires are first covered by an insulating material. They are then inclosed within a lead tube, and finally they are put in the grooves of a heavy wooden molding, with a cap screwed on over all. Thus they are protected in three ways: first, by the insulating material; second, by the lead, which prevents corrosive action; and third, by the wooden casing, which protects them from mechanical abrasions. Wherever a branch connection is taken off there is always a fuse, so that each lamp is protected by a separate "safety valve."

Every tendency toward an excessive current thus acts directly on the fuse, which, by burning out, cuts off the current. The junction boxes and cut-out boxes used in the American system of marine work present many points of superiority over the English system. They are waterproof and almost hermetically sealed. They are fitted with stuffing tubes, which perform the functions of the stuffing boxes on an engine, and their covers are supplied with rubber washers that cause them to shut water-tight.

It is only a matter of time, and probably a very short time, until the English system gives way to the American. The latter has already found its way into Government favor, Edison plants of the system that has been described being fitted to the United States ships '*Baltimore,*' '*Philadelphia,*' '*Yorktown,*' '*Concord,*' and '*Bennington,*' where in all cases they give perfect satisfaction, burning as many as 479 sixteen-candle-power lamps in the large ships. The same system is also found on the '*Orizaba*' and '*Yumuri*' of the Ward Line, and the '*Caracas*' and '*Venezuela*' of the Red D Line, each ship burning 200 lights of sixteen-candle-power. The crowning success of the American system, however, is seen on the Old Colony Line, where it is employed to light 1,800, 1,250, and 1,200 lights respective, on the '*Puritan,*' '*Pilgrim*' and '*Plymouth.*' Nobody ever heard of an accident on the '*Puritan*' or '*Pilgrim*' similar to that on the '*Etruria.*'—*New York Times.*

OCEAN RACING.

* * * * To save three or four hours on a week's run can hardly be so great a matter to the majority of travelers, and yet it is, as torpedo boat practice has so well taught us, the last bit that costs so much to get; and when the question becomes one of minutes, any such trivial advantage that may be gained at even a small risk to the passengers, is not only senseless but absolutely criminal. To go from 14 to 18 knots is a comparatively easy matter in a ship of the length of the Atlantic liners, but to increase the speed from 20 to 21 knots requires almost superhuman efforts. The vital question for the passenger is one of risk; what danger is incurred by driving the ship at its utmost? It is a factor which is often overestimated. The greatest danger to which a good steamship is subjected in crossing the Atlantic is that from collision; and when running through fog the risk is increased tenfold. But the risk of steaming through a fog at top speed is in some respects less than that incurred at a slower speed. It must be remembered that it is a question of chances, the chance whether another vessel happens to be on the same track at a time when the ship is passing over it. If we have a zone of fog covering a distance, say, of 100 miles, it stands to reason we shall only run half the chances of meeting in that area, a vessel running in the opposite direction, if the ships each cover it in five hours, than if they take ten hours to do the distance. But, it may be said, if we slow down we should have time to get out of the way. That as a matter of fact is a fallacy. The faster a ship steams the more fully she is under command of her helm, and this is especially true in the present day of steam steering gear, when the quartermaster has unlimited power at his command to put the helm over quickly. Ocean liners will never go slowly enough to enable them to stop and go astern in the event of meeting in a fog. Captains will always depend on the manœuvering properties of their ships, and the faster they go the more quickly will the rudder act; so that speed, which from one point of view is an element of danger, has its counterbalancing advantages. The opinion of our best skippers, we believe, inclines towards the greater safety for their ships being obtained at high speeds, in the matter of danger from collision in case of meeting other steamers in a fog.

So much for the external danger of collision—the same remarks do not hold good in approaching land in foggy weather—and the internal danger from breakdown of machinery remains to be considered. Here we are on more doubtful ground. The boiler question can be put aside and we may confine our attention to the engines. There is no doubt that running at the high piston-speeds necessary for fast steaming sets up stresses in the moving parts which are not brought to the same extent into play with more ordinary and moderate practice. The answer to this is that the engines are designed expressly to bear these stresses, and the machinery is so well designed that it does bear them. The most notable breakdown of engines that ever occurred to an Atlantic liner, that of the '*City of Paris,*' was not caused by fast steaming, although the fact that this vessel held the championship of speed has led to a popular opinion to the contrary having been formed; and the records of engine mishaps do not support the theory that high speeds in properly designed machinery are productive of disaster. The machinery of an Atlantic racer is more likely to be better kept up and better looked after than that of a vessel of the more ordinary description; and after all it is oversight and carelessness that is productive of the greater number of accidents.

It is in the minor aspects of the problem that ocean racing is to be judged. For the owners it is chiefly a matter of expense, higher coal bills, more costly ships with finer lines, and less carrying capacity. For the passengers the question of vibration is perhaps the most important. In one of our most noted racers the vibration is so great that probably there are few passengers who would not beg the captain to take an extra day on the voyage in order that they might get a little relief from the constant jar of the machinery, and the bodily wear and tear from shaking and unrest. No doubt mechanical science, in the matter of counter-balancing moving parts or otherwise, will meet this difficulty.

In the meantime doubtless faster and faster steamers will be built. The most effective advertisement a steamship company can get is to "break the record;" and so long as human nature remains what it is there will be those who will flock to the champion flyer, whilst there will be others who will think only of greater comfort and security.—*Engineering.*

There is another aspect of this matter

which our contemporary does not refer to, and this is the monopolization of the seas by fast ships. The ocean is for all peoples, but there can be no doubt but that the advent of a few high-speed ships adds greatly to the dangers of slow ships. These last have some part in avoiding a collision, and a very slight miscalculation on the part of their skippers can render nugatory the skill of the captain of the fast ship. Two vessels, one of 20 miles per hour, and another of 14 miles per hour come together at the rate of 34 miles per hour, at which speed there is no time to do much, if danger is imminent. If high speed on sea continues these vessels will have to be confined to certain routes in which slow vessels venture at their peril.

LINK MOTION vs. AUTOMATIC CUT-OFF.

At the last meeting of the *American Association for the Advancement of Science*, Mr. H. P. Jones, of Portsmouth, N. H., read a paper on the subject named, which is full of interest.

The author constructed curves having for their abscissa percentages of stroke and for their ordinates percentages of the total area of valve opening, belonging respectively to the standard type of locomotive link motion and to the automatic engine at various cut-offs. These curves enable tables to be prepared from which it appears that the automatic engine renders a larger proportion of the port area available than does the locomotive. For example, the automatic cut-off engine at 30 per cent. cut-off permits 43 per cent. of its total port area to be used, whereas only 27 per cent. is available in the case of the link motion.

It is a natural inference that such difference of valve opening would cause considerable difference in the amount of wire-drawing or distortion, as shown by indicator cards.

Examination of indicator cards from the two types of engines, show, however, that for equal piston speeds, and proportion of port area to piston area, the locomotive gear gives indicator cards quite as perfect as the automatic gear, and that the well-known distortion or inclination of the locomotive cards during admission only appears at piston speeds which require a mean velocity of flow of the entering steam above 250 feet per second, which, while frequently demanded in a locomotive, rarely exists in stationary engines which present more perfect indicator cards.

It was further shown by discussion of indicator cards presented, that while the most perfect cards were afforded by "trip motion," cut-off gears like the Corliss, the following conclusion practically apply to all good valve gears, including the locomotive link motion, the automatic cut-off or high-speed engine, the Meyer cut-off and the Corliss cut-off.

1. To avoid more than about one pound loss of pressure between the steam chest pressure and during admission to the cylinder, the mean velocity of the flow of steam through the ports during admission must not exceed 40 feet per second.

2. The admission line remains parallel to the atmospheric line up to a mean velocity of flow of about 250 feet per second, notwithstanding that the loss of pressure between steam chest and cylinder may be upwards of 25 pounds per square inch.

3. Distortion or inclination of the admission line occurs above 250 feet velocity of flow, and in locomotives at 55 miles per hour the velocity of flow is upwards of 400 feet per second. Hence the loss of pressure between the beginning and end of the admission line is upwards of 25 pounds in this type of engine.

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The boilers of locomotives on English railways are seldom provided with gauge-cocks. Two water glasses are used to show the water in the boiler, one being placed upon each side. Automatic cylinder oilers are not in general use, and, instead, the well-known "tallow cup" is mounted upon each side of the cab.

EDUCATION vs. ILLITERACY.

Illiteracy in its lowest form is inability to read or write. To learn the alphabet would be an upward movement, and there are thousands who, when theyc an scrawl their names and read imperfectly, concern themselves very little about further progress. If such advancement is not stimulative of ambition to know more, it is doubtful if their acquirement is of any value whatever. On the other hand, if learning to read and write awakens ambition to know more, there is scarcely anything within the range of useful knowledge that a young man may not secure.

The American idea is to educate the masses, because it is held that should illiteracy prevail the institutions of the country would be imperiled. It is not believed that an educated people can be enslaved, but it must be understood that in no proper sense is the mere ability to read and write to be regarded as education.

When education, however limited, inspires ambition to know more, it may be said, like the seed in the parable, falling upon good ground, that it will bring forth an abundant harvest. The statement is often made that an American workingman, in the same number of hours, produces more than an European workingman, and the reason assigned is, that the American is more intelligent, that is to say, his head as well as his hands have been educated; mind and muscle are in alliance, and when that is the case, not only more product, but a better product, may be expected.

It need not be said that education is elevating and that illiteracy is debasing. Such propositions have long since been dismissed from debate, but it may be said that thousands of workingmen do not appreciate in any proper measure the lifting and advancing power of education. Starting in life with a limited education, they seem content to remain unimproved intellectually, except in so far as improvement comes from absorption. They catch here and there an idea, an explanation, a suggestion, and are satisfied. They spend their money in ways that contribute nothing to the development of their intellects, their mind forces; they do not purchase valuable books, but squander their leisure in idleness rather than study.

As we have said there is work for such men, but it is not the most remunerative, and it is needless to say, that in every branch of work the time has arrived when illiteracy has become a bar to advancement. The man who is ignorant and who is content with his condition, may make up his mind to remain where he is—at the tail end of the procession. There is absolutely no promotion for him, while for the man who comprehends the value of education, of knowledge, and determines to master problems in the line of his calling, will be wanted for responsible and remunerative positions.

Fortunately, if a man at twenty years of age finds himself illiterate, he can, if ambitious to secure a useful education, stand high among men of knowledge when he is forty years of age, and at forty he is in the very prime of his manhood. He will understand the English language so thoroughly that he will be able to speak and write it correctly. The library, and not the saloon, will be where he will spend his lesuire if unmarried, and at home, if married.

The time has come when ignorance will be tolerated only at the bottom round of the ladder, or very near it. Ignorance can't climb. It is stationary. In decides the fate of its victims. To escape the degradation it inflicts a man must study, and if opportunities are limited he must be the more determined—the more resolute. He must not be ashamed of the rudiments. Books are cheap. The schoolmaster is abroad. Two hours a day devoted to study is equal to 730 hours a year, or 73 days of 10 hours each. If, for five years, two hours a day are devoted to study, a man has secured one year, 365 days of 10 hours each, and in twenty years, four years of student life. And as we have said, at that time he will be accepted as an educated man thoroughly equipped for responsible positions.

It may be said that we have discussed the subject from the standpoint of wages. That is true. The educated workingman in the long run will receive the higher wages, because he will be wanted, while the ignorant man will not, as a general proposition, advance.—*Locomotive Firemen's Magazine.*

PLEA FOR A UNIVERSAL LICENSE LAW.

In his recent address to the National Association of Steam Engineers, John Fehrenbach, late president of that body, said:

Every State in the Union, as well as the Federal Government, has provided for the better protection of property, human rights, human liberty, as well as human life, by prohibiting the practice of law by all persons except such as has passed a thorough and rigid examination before a legally constituted board of examiners, and received a diploma, or license, as evidence of their qualifications to practice law. If it were not for that, the property of the citizen, his rights, his liberty, and in many instances even his life, would be placed in jeopardy. The citizen whose title to property is to be determined before a legal tribunal, or whose rights are, or whose liberty is, at stake, or who is on trial for his life, is entitled to competent legal services. The statutes, therefore, justly provide that persons ignorant of the law, especially that pertaining to property, human rights, human liberty, and human life, shall be excluded from the practice of it.

If it is important, therefore, that the community should be protected against the practice of medicine or law by incompetent persons, how much more important is it then that the community should be protected against the ignorant, careless, reckless, or incompetent engineer.

Owing to the absence of any law, with a few isolated exceptions, permitting none but those thoroughly qualified to be entrusted with the important position of steam engineer, thousands of human lives are daily and constantly placed in the most imminent danger, to say nothing of the many annually sent to untimely graves, or of the millions of dollars worth of property sold. * * *

To accomplish this desirable result, and to afford better protection to life and property in connection with steam engineering, it is indispensably necessary that our association should devote its entire energy to the education of steam engineers and to securing the passage of stringent and effective license laws in every State in the Union. To hasten the accomplishment of this laudable purpose, the united efforts of this great convention must be exerted in devising plans for carrying on the work in the most effective and speediest possible manner. * * *

In order to accomplish this great work in the best and speediest, as well as the most efficient manner, this convention should establish a uniform rule of action for the guidance of local associations, the want of which has hindered very greatly the work of securing the much-needed legislation in many of the States of the Union. In some parts of the country efforts are being made to secure the enactment of steam boiler inspection laws, while in many places the demand is made for engineers' license laws, pure and simple. The latter, in my judgment, is most likely to be secured. It is the least objectionable to those who would otherwise oppose our efforts or attempt to thwart our aims. Therefore, if this convention will declare in favor of the enactment of license laws, without the steam boiler inspection feature, it will do much toward removing a most formidable opposition and turn it into one of co-operation and hearty support. You, therefore, have it in your power to hasten or delay the day when every steam engine from the Atlantic to the Pacific, and from the lakes to the gulf, will be in charge of a competent and reliable engineer.

EFFICIENCY.

The term "efficiency" in mechanical science has become technical, and restricted to a definite mathematical expression in the form of a ratio. When thus used its meaning is well understood, but its importance is increased by giving to it a broader definition and a wider range of applications.

Efficiency is a result compared with the effort expended in producing that result.

This implies a division, and therefore may be expressed as a fraction, and, if it be abstract, a common unit must exist between the effort expended and the result obtained. If one be in the thermal units, the other should be; if one be in pounds, or dollars, or feet, or time, or any particular quality or quantity, the other should be respectively the same We will illustrate these principles by a few examples. Beginning with the familiar one of the steam engine, we may have the following efficiencies: If 10 per cent. of the energy of the steam admitted into an engine be transmuted into work, then will the efficiency of steam, compared with the energy in it when admitted to the engine, be one-tenth, or 10 per cent. If 5 per cent. of the energy of the steam in the boiler be lost by radiation, leaks, friction, etc., in passing from the boiler to the cylinder of the engine, then will the efficiency of the steam, compared with its energy in the boiler, be $0.19 \times 0.95 = 0.095$, or $9\frac{1}{2}$ per cent. If the efficiency of the boiler be 0.70, that is, if the boiler utilizes 70 per cent. of the theoretical heat of the fuel, then will the efficiency of the system referred to fuel be $0.95 \times 0.70 = 0.0705$, or more 7 per cent. If the fuel be coal, and the heat in it be one-fourth that in the plants from which it was produced, then would the efficiency of the system, compared with the heat in the plants from which coal was produced, be 0.017625. If the heat energy in the plants be 1 per cent. of the energy received from the sun (and this is probably a very high allowance), then would the energy of the system referred to the original source of energy—that of the sun—be 0.0017625, or less than one-fifth of one per cent. We have referred to the sun as the original source, for we are ignorant as to its source of energy. Speculation is not agreed in regard to it; it may be the result of combination, or of a shrinkage of volume, or the impact of external masses, or it may be an expenditure of original energy, and in these speculations it is generally assumed that the entire mechanical energy expended is entirely transmuted into heat, in which case the efficiency of such heat operation would be unity.

The efficiencies here given are less than unity, and it is always less than unity when the result is obtained from the source without an intermediate agency, deriving more or less power from another source. When the latter condition is involved the efficiency may exceed unity. For instance, if money be carried, or deposited with another without being used, its efficiency could not exceed unity, and, although practically the efficiency may be unity, yet considering friction, wear and tear, and accidental losses, it is liable to be less than unity. If, however, the money be loaned, and the borrower uses it in trade, commerce or agriculture, he may be able to pay for the use of it, and if he pay 6 per cent. periodically, the efficiency of the lender will be 106 per cent. If the borrower expended the money in raising a crop of wheat, and received five times as much money for it as he expended, the efficiency would be 5, or 500 per cent. In this case the soil and other elements of nature constituted an intermediate agency which contributed to the result independently of the money expended in labor, seed, etc. If, however, the crop be referred to the wheat-producing capacity of the soil—that is, if the chemical elements of the wheat be compared with the corresponding chemical elements in the soil—the efficiency would be less than unity, and might be only a very small fraction.

The efficiency of a refrigerating plant is by some referred to the thermal units of work done on the fluid by the compressor, in which case the efficiency exceeds unity; for the compressor in practice adds only a small part of the heat that is removed by the refrigerator, the other part being absorbed by the circulating fluid from substances not affected by the compressor, and the latter measured by the work of the former. Even in this case the efficiency may fall below unity when the result is compared with the energy expended in operating the compressor.

Negative efficiencies are ideal, and are not reported in practical operations. Since all efforts, all work, all energy, are positive when considered by themselves, negative efficiencies exist only in the sense in which one effort is considered in reference to another. Thus, steam in an engine does work, but air admitted to compressor does not work, but work is done upon it. In the sense of its doing work when driven it is negative. Again, if a man promises to pay five bushels of wheat for the use of a wheat field, and the crop were an entire failure, the efficiency is strictly zero, and if he delivered the five bushels according to agreement, he would necessarily secure it from some other source, and the efficiency of the transaction would be negative.

As for an imaginary efficiency, it has often proved a reality to visionary dealers.

It is unnecessary to illustrate further, and we simply mention a few other subjects to which it is, or may be applied. The efficiency of a beam is the ratio of the load it carries to that required to break it, and is the same as the factor of safety. We have the efficiency of riveting, of belt transmission, of the flow of fluids through orifices and pipes, of a bank, of an instructor, of a student, of an institution of learning, of a journal, of an official, etc. Many of the latter cannot be expressed mathematically, for the quantities do not admit of exact measurement. While it may be said that one man is more efficient than another, yet if it be said he is twice as efficient it will be considered as a matter of judgment, and not the result of measured quantities.—*Professor De Volson Wood.*

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"I am constantly meeting with men who inform me in all earnestness of some wonderful invention which is going to revolutionize everything. A few days ago this took the form of a means of so applying the force of water to a contrivance down a well as to force a lot of water to the surface, besides returning the working stream also. It is rude to contradict, so I listen and say nothing, long ago convinced of the inutility of trying to explain things to the uninitiated, who, after all, won't believe you, but set you down as 'another self-opinionated engineer,' who is 'so blinded by old-fashioned ways that he won't believe anything new.' There are probably never less than a dozen men in existence at any one time who are trying to get behind some natural law with a spring device or a system of weights and levers, or elliptic gearing. Few of them contrive machines to run so long as Keeley's motor, or to be so profitable (to the inventor). Mechanical engineers may rest and be thankful for a time, however."—*W. H. Booth, in American Machinist.*

◆

An eminent Polish physician, Jaworski, has been experimenting to determine the effects of acids and alkalies upon the stomach. He finds that acids precipitate mucus, cause bile to flow into the stomach, increase the amount of pepsin in the gastric juice, but not its acidity, diminish the flow of gastric juice, and in excess, produce disturbances of digestion. Alkalies, on the other hand, dissolve mucus and decompose pepsin. These facts explain the evil results arising from a continued use of vinegar, baking powder, saleratus, soda, and similar substances commonly used in cookery.

A system for lathe and planer tools akin to that used in milling and moulding machine cutters and gear cutters has been introduced in England.

The device consists of a holder, which will fit any of a number of different tools, and a set of disks, the periphery of which is of the proper form for the work the tool is to do. This disk has a stalk, by means of which it is gripped in its holder, and a cutting edge is given by grinding its periphery radially from its circumference. The tool is given its proper shape once for all, and thereafter is maintained in working condition by grinding. Probably the most striking of the different forms is a chasing tool, in which the thread is carried right round the edge of a disk some 4 in. or so in diameter. Chasing tools are always somewhat expensive to make and are ground away comparatively quickly, as there is generally considerably less than a single inch of screw on them to start with. In the new tool there is a length of about 10 in., which can be ground away before the tool is finished with. Another adaptation of the principle is to a compact boring tool. The holder in this case is hollow, and the disk is held against one end of it by a bolt passing through the holder and secured by a nut at the other end.

◆

We recently came across a neat little device for draughtsmen which was extremely simple. It consisted of a piece of tracing cloth 4×7 in. pasted on a card of the same dimensions, with the corners rounded off. On the cloth a number of circles of different diameters, ranging from 3-64 in. to 1 in., were drawn in ink. Above each circle was marked its actual diameter, while below it was the size it represented on a scale of $1\frac{1}{2}$ in. to the foot. After the figures were on the cloth was shellaced. Its use is obvious, and besides saving considerable time, it does away with the necessity of sticking the poins of a compass into a scale, to the detriment of the latter. Of course any draughtsman can make one for himself to suit the scale he most frequently uses. He should be sure, however, to draw the circles after the cloth has been pasted on the card, otherwise the shrinkage will seriously interfere with their accuracy. We understand that Mr. J. W. Beach, late of the Erie road, got up the first of these handy little labor savers.—*Master Mechanic.*

There is no need of any scale when drawings are marked in plain figures, as they should be.

◆

Hiram Maxim, the inventor, says that he has decided to expend $10,000 in trying to discover a means of propelling an air ship. "I hired a large mansion near London about a year ago," he said, "and equipped it with American machinery, and engaged a number of American workmen, for I consider Americans the best mechanics in the world. With this outfit the experiments were begun. The work so far has largely been confined to determining the coefficient of screws running in the atmosphere, and the lifting power of planes propelled at great velocities The results have been satisfactory. I have built a double engine and generator which weighs only 1,100 pounds, and can develop 500 horse-power. This is said to be the lightest and strongest engine ever built, with a large factor of safety in every part. It will be some time before the world will know whether my proposed machine will fly."

◆

The French Post-office authorities have lately been making experiments with a new wire, composed of steel with a surface of copper. It has been adopted to replace the wires in the telegraph service, and will also be used upon the telephone systems.

◆

Pruritus, or itching of the skin, is very common, and nothing is found to be so effectual as a mixture of equal parts of lime water and glycerine, applied as often as necessary.

TRADE NOTES.

WILLIAM LOWERY, one of the oldest engineers and machinists in this city, died recently at his home in Williamsburg at the age of eighty-one years. Mr. Lowery was for many years at the old Novelty Works, and was an engineer in the Collins Line.

* * *

THE new depot of the Pennsylvania Railroad at Jersey City will, when completed, be the largest passenger depot in the world. Its length will be 256 feet, which is seventeen feet longer than the St. Pancras Station, London, England. The arched roof will be ninety feet high in the center.

* * *

AN application has been made to the Board of Estimate and Appointment for an appropriation of $10,000 to erect a monument to John Ericsson. If this sum should not be sufficient, as it probably would not, the promoters of the scheme promise to make up what is necessary by public subscriptions. The committee consists of William C. Church, W. W. Webb, Ashley W. Cole. V. F. Lassoe, George Inniss, Jr., S. W. Taylor, Thomas F. Rowland, and John D. Crimmins.

* * *

THE '*Petrel*,' U. S. N., lately lost one of her $600 whaleboats, apparently through the carelessness of her commanding officer. The whaleboat had been swung on its davits over the side of the ship. A certain direction of firing was given, which, if carried out, would destroy the boat. The master gunner reported the exposed position of the whaleboat, and added that the firing of the gun would knock the bottom out of the boat. The commander retorted: "Oh! it will, will it? Well, fire the gun!" The gun was fired and the boat was knocked into splinters.

* * *

AT a recent trial of armor plates in the Washington Navy Yard, the French plates proved superior to the English. When the firing ceased the two Schneider plates were practically as good as ever for protection, and none of the shots would have done much damage to anything behind the plates; in the case of the Cammell plate it was practically destroyed, and any of the shots fired at it would have done considerable damage to a ship if it had received the shots under the same conditions. Representatives of the Cammell Company expressed satisfaction at the fairness of the test, and were surprised at the result so far as the Cammell plate was concerned.

* * *

THE new revenue cutter building by Reeder & Son, Baltimore, will be the largest in the service of the United States. She is designed for not less than 15 knots an hour. The power is supplied by twin screws operated by compound engines, with cylinders 15½ and 27 inches, stroke 2 feet. Steam will be generated by two fore and aft boilers, about 9½ feet in diameter and 11 feet in length. There will be but one fireroom, midway between the boilers. The boilers will carry 100 pounds pressure.

Coal will be carried in four bunkers. The new vessel will have two funnels and steel masts, the lower and top masts jointed. In length she will measure 200 feet, with a draught of 10 feet.

* * *

THE Cataract Company, who are to develop 120,000 h.p. at Niagara Falls, have determined to invite a commission of scientific men, consisting of Sir William Thompson, Prof. Unwin, Prof. Mascart, Colonel Turrettini, and Prof. Coleman Sellers, to consider plans. We will suggest that the disinterested criticism of these eminent men would have come much cheaper and been of more value without their being appointed. The problems to be dealt with are not those of the laboratory, and, so far as we know, none of the proposed commission, except Colonel Turrettini, has had anything to do, practically, with water power plants. Engineers like Emerson, Leavitt, and Emery, would come nearer understanding the requirements.—*The Journal, Industry.*

* * *

THE '*City of Seattle*,' Ss., built by Messrs. Neafie & Levy, for the Puget Sound and Alaska Steamship Company, will leave for her destination in a few days. She is a three deck ship, 260 feet long, 40 feet beam, and 17 feet depth of hold, and of 1,410 tons register. She has accommodations for 250 passengers. The engines are compound, having cylinders 32 and 60 inches diameter by 36 inches stroke. Steam is supplied by two steel boilers, each 13 feet in diameter by 14 feet long, carrying 145 pounds. The propeller is 11 feet in diameter, with 18⅓ feet pitch. On a trial trip a few days ago she developed a speed of 16½ knots. The '*City of Seattle*' is intended principally for fast passenger service, and, during the summer months, will run between Seattle and Alaska, and in winter to Port Townsend, Victoria and Tacoma.

* * *

THE Globe Iron Works Company, Cleveland, O., have ordered two more Worthington independent condensers, so that the whole fleet will be equipped with this necessary, making eight independent condensers that the Globe Company have ordered within six months. This is certain proof of their advantage, as is the improved speed shown by these two liners. The '*Emily P. Weed*' also has one of these condensers. The Lehigh Line and probably two other lines will have attached air pumps removed this winter, and have the independent condensers put in. One reason for this is the record of attached pumps breaking down, one boat having lost four days recently through an accident of that kind. The wooden steamship recently contracted for by John Mitchell, to be built at Wheeler's yard, will also have an independent condenser.—*Marine Review.*

* * *

PLATINUM is in danger of becoming a thing of the past. For the last six months the price of the precious metal has been rapidly advancing, until now it has made an advance of over sixty per cent. of the original price. The demand is greater than the supply. The advance is attributed to the large number of electrical works in operation throughout the United States. The amount of platinum used in the manufacture of electrical apparatus is enormous. Each electric light contains about six inches of platinum wire, and if the metal is not pure it will not stand the great heat. As the electric light grows more in favor the demand for platinum is greater, and, unless some substitute can be procured, the chances are that platinum will be indeed a precious metal. Platinum at present is worth $14 an ounce, gold $20.70, and silver $1.18.

* * *

"Everywhere I see, in iron-working establishments, the careless, the indolent, the incompetent workman," remarks a writer in *Iron Industry* Gazette. "Who is responsible? Plainly, the owners and superintendents, because they permit careless men to break tools, smash machinery, and the indolent men to go on wasting time and getting pay as though they performed the proper amount of labor. If the owner refused to hire such men, or if he charged them for the breakage caused by their carelessness, and paid them only for the time they work, they would disappear from shops."

[This is too sweeping. We do not see bad workmen everywhere, but there is no question that there are too many of them. The cause of it is a mistaken policy on the part of managers, who think that two $2 men are better than one $4 man.]

* * *

PROFESSOR MCGEE, of the United States Geological Survey, expresses the opinion that Professor Orton's theory regarding the exhaustion of the supply of natural gas is correct. He says: "It will fail; it may be a long time yet, but it will surely fail." There is little reason for doubt that this is true. All wells that have been heavily drawn upon for a period of three or four years have gradually diminished in pressure. Some have become useless; others have been almost wholly exhausted, but after being securely closed they have become stronger than they were at any time before. The supply can be so husbanded that exhaustion becomes improbable. The fact that wells can be so managed is inference that there is continuous generation, and that the production is sufficient to supply moderate demands indefinitely. Exhaustion becomes imminent only when there is wasteful or too rapid use of the supply.

* * *

THE California Mill, at Virginia, Nev., has been running for nearly three years with Pelton wheels in one of the deep shafts, and a long wire rope transmission for a distance of 3,500 feet, of which 1,500 feet is vertical. There are four Pelton wheels, the first, at the surface, is 10 feet in diameter under a head of 460 feet. The water from this wheel is conducted to the shaft and passes down in falls of 500 feet each to three more wheels. So the total fall is 1,960 feet, divided into four sections. The wire rope transmission causes no trouble. This is probably the only case in the world where power has been transmitted vertically 1,500 feet out of a mining shaft and then transmitted 2,000 feet over the ground to a mill. This system has been in operation for nearly three years and has been very satisfactory.—*The Journal, Industry.*

* * *

THE project of ship railway to connect Lake Huron with Lake Ontario is being agitated, in lieu of the proposed ship canal. The distance between these two great lakes is only 67 miles, by the proposed route from Georgian Bay to the mouth of the Humbar River, west of Toronto, and it has been figured that a railway, with three tracks of the standard gauge, but with rails weighing from 100 to 110 pounds per yard, could be built for $12 000,000, or about half the cost of a ship canal of the same capacity. The land along the route reaches a height of 664 feet above Lake Huron, so that there would be some very heavy grades or else some tremendously expensive work necessary. The proposed route, it is said, would save 428 miles of lake navigation, and 28 miles of canal between Chicago and Montreal, and would enable a propeller to reach Montreal from Quebec in less time than it can reach Buffalo. The expected saving of three days in the time between Chicago and the seaboard is certainly a consideration which would warrant a large expenditure if the project is feasible from an engineering standpoint.

* * *

THE Central New York Telephone and Telegraph Company, of this city, has devised a plan by which the induction to its lines by the electric current on the wires of the Belt Line street railroad is in a measure overcome. When the electric cars were first operated, and at times since, patrons of the telephone company have complained of a buzzing sound in the instrument when the receiver was placed to the ear, making it difficult to understand the person at the other end of the line. Trouble was also occasioned in the exchange by the frequent falling of the annunciator when no one had sent in a call. Investigation by the company's electricians revealed the fact that the trouble was occasioned by the electric cars. The current from the undeground wires of the railroad spread out and interfered with the return circuit of the telephone company. The difficulty can never be entirely obviated, but a plan has been hit upon by which the service is greatly improved. A large copper wire has been run from the central office between the line wires on which the 'phones are connected, and thence into the ground, thus establishing a balance between the two currents.

THIS is one of the commonest communications to a technical paper:

"My attention has just been called to an article in a Texas paper, entitled 'High Rate of Speed,' in which it is stated that a correspondent asserted that a speed of 100 miles an hour by steam locomotives was among the possibilities, or, to use his exact words, 'was entirely practicable and thought it would be attained.' I wish to say that there is a party here who has invented a device which, *I believe*, will accomplish such a result, and that too with less danger than at the rate now run by railway trains, etc."

"I believe." Does the correspondent think people will advance money upon the basis of belief in a man who has no right to express an opinion? simply because he, knowing nothing about the subject, is not competent to judge.

ONE of the commonest occurrences in a machine shop is to put a finger into a threaded hole when the same is in motion, in order to clear it out. A writer in the *American Machinist* relates a case of this kind. A boy had a job in a chuck, and stuck his little finger into it to clear the hole out when it was running; his finger caught on the thread and ran in, but, luckily he stopped the lathe before the finger was twisted off. The job had to be taken out of the lathe and destroyed before the finger could be released.

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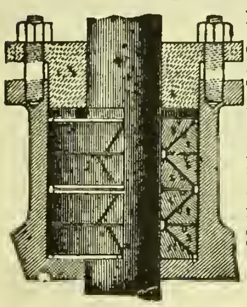

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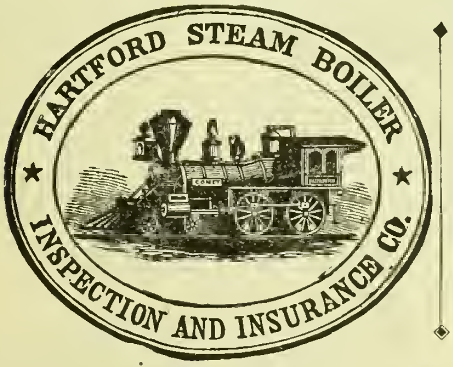

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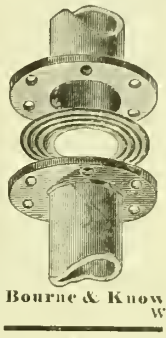

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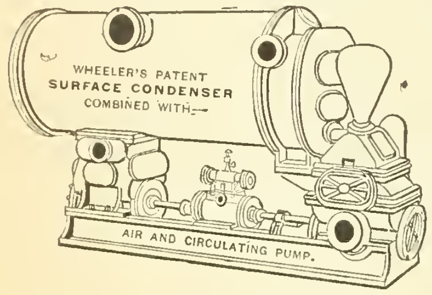
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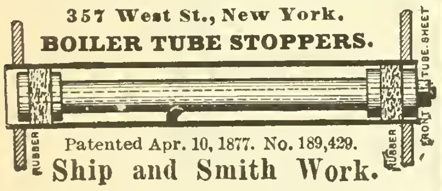

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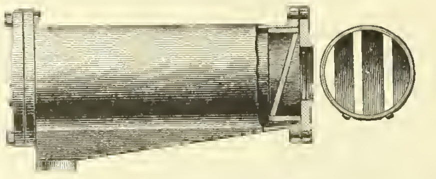

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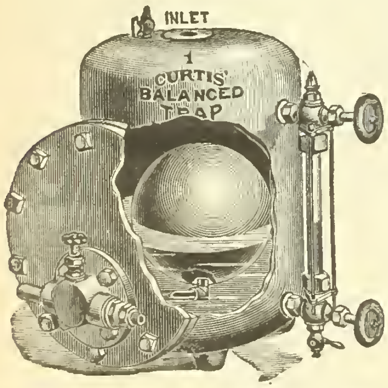

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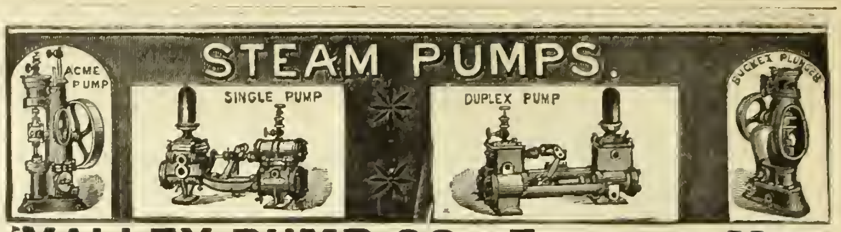

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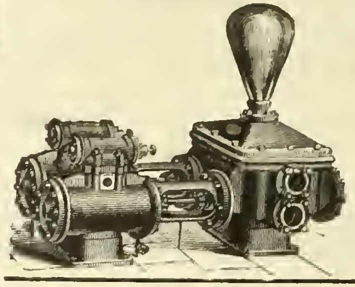

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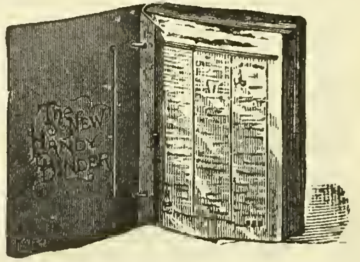

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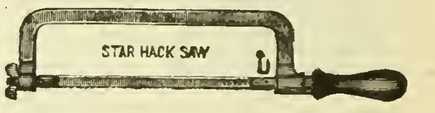

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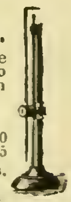

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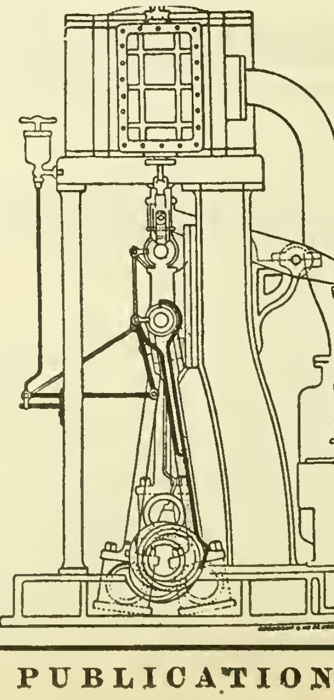

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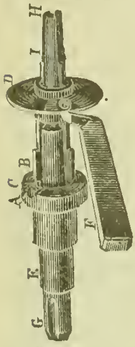

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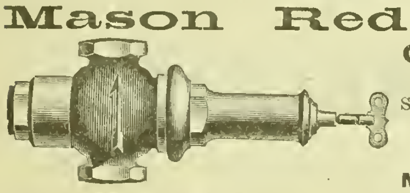

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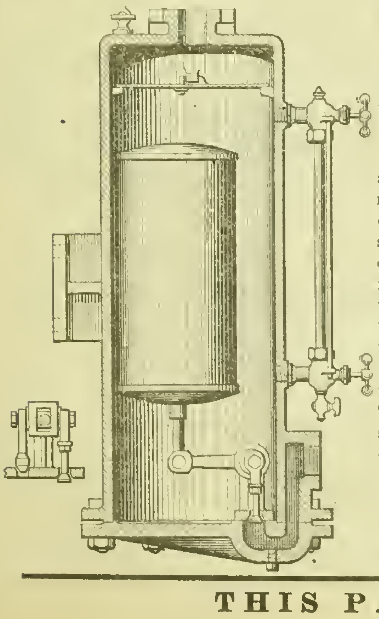

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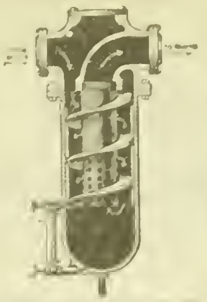

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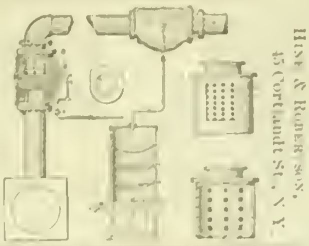

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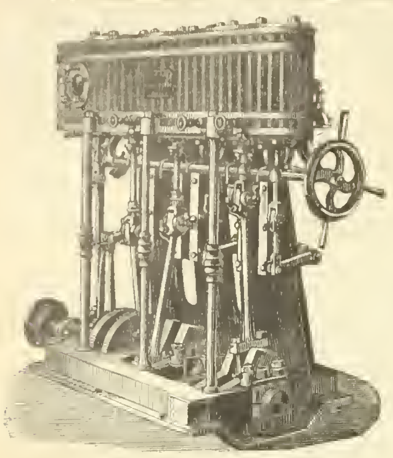

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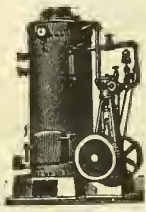

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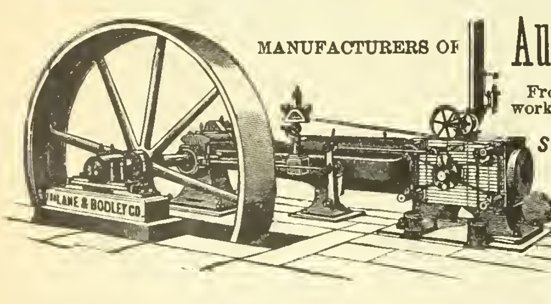

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FOR LOCOMOTIVES, STATIONARY, MARINE AND PORTABLE BOILERS.

It does not infringe on the patents of any valve made.

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Approved, and its adoption recommended on U. S. Naval Steamships, April 1, 1885, by U. S. Naval Board of Examiners.

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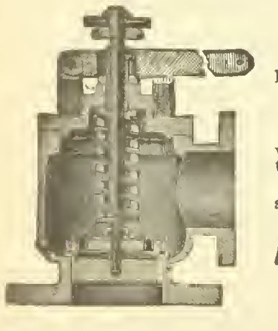

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THE ENGINEER.
NEW YORK

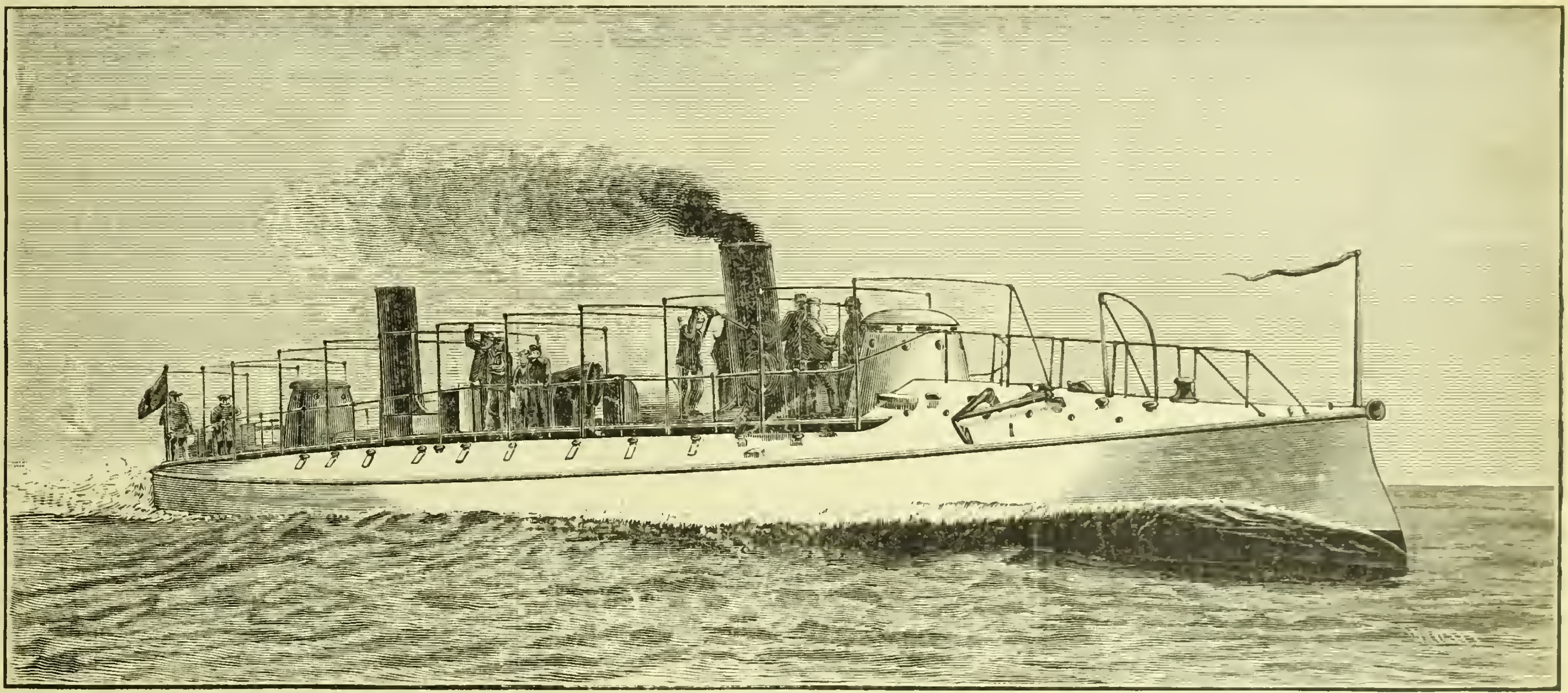
NEW SERIES, 1883, 1888. **Vol. XX. No. 8.**
TENTH YEAR OF PUBLICATION.
STEAM ENGINEERING, APPLIED

October 18, 1890.
$2.00 PER ANNUM. - SINGLE COPIES, 8 CENTS
MECHANICS, AND THE ALLIED ARTS.

THE 'CUSHING,' U. S. N., TORPEDO BOAT.

WE present herewith an engraving of the '*Cushing*,' the first high-speed torpedo boat the Government has ever built. The exact speed of this vessel is not known, but has been variously stated at 22.5 knots, and as high as 24.5 knots, which last we believe is not a matter of record.

The '*Cushing*' has been constructed for the purpose of discharging automobile torpedoes, (those carrying their own propelling power) while she is running at a high rate of speed. She is 138 feet long, 15 feet wide, 10 feet deep, and draws 4 feet 4 inches. Her displacement is about 100 tons. The '*Cushing*' was required by contract to make twenty-two knots an hour. For every fourth of a mile above twenty-three knots per hour there was a bonus of $1,500, and for every quarter of a knot above twenty-four knots an hour a bonus of $2,000.



The hull is divided into eleven water-tight compartments, and she will carry 35 tons of coal, and with a coal endurance at maximum speed of 3,000 knots. The hull is built throughout of steel plates.

Above the water line the '*Cushing*' shows two conning towers and two smokestacks. A whaleback runs from the forward conning tower to the bow. The whole deck is of steel, curved to deflect shot.

She has two Thornycroft water-tube boilers built by the Continental Iron Works of Brooklyn, N. Y., the first of the kind constructed in this country. Each boiler has thirty-four feet of grate surface, 1,800 feet of heating surface, and two miles of steel tubes. The fire rooms are on the closed stoke hold principle. They will be closed nearly air tight, and a fan-blower will draw air from an opening in the deck.

The main engines are two sets of 5-cylinder expansion engines of 800 h.p. each, and there are a total of twenty-eight steam cylinders on board. The high-pressure cylinders are $11\frac{1}{4}$ inches in diameter; the first intermediate 16 inches, second intermediate 22 inches, and low-pressure 22 inches. The stroke is 15 inches. The main shafts $5\frac{1}{2}$ inches in diameter, and 61 feet long, are of forged steel, and the twin propellers are of manganese bronze 4 feet 2 inches in diameter, with 8 feet pitch. A reducing valve allows the use of direct steam at starting.

The conning towers are of quarter inch steel, with double sliding doors, arranged so that one (if injured in action) can be substituted for another. They are lighted by bull's-eyes, and their domed tops can be elevated by screws so that four inch clear space can be had. Both towers are fitted with steering apparatus, engine room telegraph, and with speaking tubes connecting them. The forward tower has a steam steerer that will throw the helm from hard a port to hard-a-starboard in three and a half seconds, or before the vessel can travel her length at full speed.

The automobile torpedoes can be fired at a speed of 40 feet per second, while the '*Cushing*' is traveling 38 feet in the same time. They will be discharged by an explosive compound. The two bow torpedoe tubes are placed under the whaleback at an angle of three degrees with the horizon. They are 14 feet long and 14 inches in diameter. The '*Cushing*' will also carry other torpedo tubes and rapid-fire guns on deck.

◆

IT should be noted that the engines of the '*Normannia*' made 95 revolutions per minute on her trial trip. This is a piston speed of 1045 feet per minute, which is quite as high as locomotives make in general service and is certainly astounding. It serves to show the perfection of the workmanship on modern marine engines, when they can be driven at such speeds without disaster. Comparing them with the ancient side lever engine speed of ten and twelve revolutions per minute and 240 feet per minute piston speed, we need no longer wonder at the high power developed in modern steamers.

◆

IT is an old story that doctors disagree, but it is not very satisfactory to the student when he finds an elaborate experiment carried out with all the paraphernalia, and with all the means at hand for success to know that they disagree. It seems in engineering that we realize fully "thus far shalt thou go and no further," for beyond certain well traveled paths we are confronted with the "assumption." In plain words, this is guessing at what is obscure, and it depends entirely upon our faith in the guesser's sagacity, or ability to guess correctly, as to the faith we put in his assumption. Some elaborate trials upon triple-expansion engines were recently made in an English college, and no efforts were left untried to get facts. The observers were capable and well trained, yet their results are challenged and not accepted by other capable and well trained observers. The arguments, propositions and foundations, even, of the experiments were demolished, and shown to be erroneous, or at any rate impossible of proof, and the objectors proceeded to erect other tables and derive other results from the data collected by the original observers. This is all very unsatisfactory to positive people, who like to see a pound weigh sixteen ounces or a foot measure twelve inches, and derive all their knowledge in the profession from those facts. It is also a lesson of another kind, for it teaches that men are not necessarily false prophets or disseminators of error because their conclusions do not agree. Who is right and who is wrong? The progress of the time shows us that we are capable of judging only so far as our candle throws its light.

◆

QUITE the newest idea in railway spikes is to bend them, and patent the bend. A crooked spike would seem a bad thing to drive, but the engraving of it shows that it goes straight, while the straight spike (in comparison with it) smashes the tie badly. There is great virtue in engravings!

A NEW METHOD OF MAKING FUSED WIRE JOINTS.

It is well known that a joint of any kind in an electrical conductor offers more or less resistance, no matter how well it may be made. The soldered joint, when carefully made, is the most practical and best method of joining conductors yet brought into use. But a poorly-made soldered joint is even worse than a simple twisted joint; for chemical action and electrolytic action are sure to take place if there is the least moisture present. But, even in the absence of moisture, the resistance of the joint will cause heat, and heat increases the resistance. These effects are quite well known, and it is understood the heating at a joint increases as the square of the increase in the current strength. There is another effect, not so well known, that occurs in an electric circuit wherever two different metals form a contact, as in the case of a soldered joint. This is known as the Peltier effect, and consists of a heating or cooling of the junction, according to the direction of the current through the joint. This effect does not increase in the same ratio as the heating effect, on account of the resistance; for, while the latter increases as the *square* of the increase of the current, the Peltier effect increases *directly* as the increase of the current. This effect might be utilized, under certain conditions, to partially overcome the heating effect due to the resistance. In the case of a soldered joint where the solder completely covers the copper, as it will do if the soldering has been well done, the current passes from copper to solder, and from the solder to copper again, and the Peltier effect is neutralized; but, if the joint is poorly made, the heating effect is greatly increased. In order to avoid these difficulties, or at least to overcome them as much as possible, Frederick J. Smith, an English electrician, has made use of fused joints, and claims that his experiments, extending over a number of months, prove that fused joints wholly prevent the occurrence of these effects. The method of making the joints consists in the use of an oxyhydrogen blowpipe flame for fusing the wires together. A V-shaped groove is cut in a piece of firebrick, or a piece of hard quicklime; the ends of the wires are placed side by side in the groove, and the flame of the blow-pipe is directed upon them until the ends fuse together, which they will do in about the time required to solder a similar joint by the usual methods employed. Care must be taken not to prolong the heating after fusion is complete; for, if the heating is continued much after fusion, the copper is suddenly converted into minute globules, which scatter about and leave a thin place where the joint should be. By this method joints can be made in large wires. No flux is required nor is it necessary to clean the wires before the heat is applied.—*Practical Electricity.*

◆

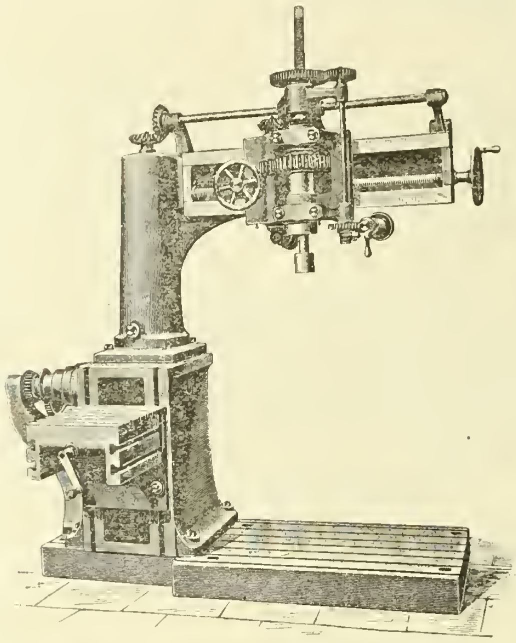
A correspondent of *Indian Engineering* suggests an original scheme for smoke abatement by asking whether it has ever been proposed to have a smoke duct running through a town connected with the different furnaces. He suggests that such a duct might be carried outside of the city to a condensing station, an exhaust machine being employed to force the draught. At the condensing station the soot-laden air might be made to pass through water and thus deposit the solid matter, the air passing away comparatively pure, while the soot thus deposited might easily be collected, caked and sold as fuel. The size of the duct would have to vary, as in water and other mains, according to the work to be performed.

◆

If in vulgar parlance we "stick a man," we cannot expect his trade in future. It takes many years to build up a reputation by fair dealing, but, when obtained, it is both a pleasure and a profit.—*Wade, Fibre and Fabric.*

THE "STAND" RADIAL DRILLING MACHINE.

The illustration represents a new type of radial drilling machine made in England. The distinctive feature of it is that, while having the advantages of a box bed, it dispenses with its use. The machine is mounted on a cast-iron stand, upon which a table is placed, with T-grooves on the top and sides. This construction permits of the table being raised or lowered to accommodate the articles being drilled, but in order to allow it to take in large work, the base-plate is T-grooved, so that the work can be fastened in position. The machine, as shown, can drill within a radius of 4 ft. 6 in., and has a spindle 2 in. diameter. A variable self-acting traverse can be given to the spindle for a depth of 14 in., and between the spindle and base-plate jobs 4 ft. high can be fixed. The distance between the side table and spindle is 16 in. and 32 in., when the former is in its highest and lowest position respectively. The spindle is of steel, and is driven by a long tube with gun-metal bearings above and below. It is fed by a screw fitted with an adjustable nut for taking up any end play, so as to permit facing work being done. In order to fit the machine for a great variety of work, single and treble gear is provided, the former being used when drilling and the latter when boring. The carriage can be adjusted from the end of the arm or by means of the hand-wheel shown on the carriage itself when fine adjustments are required. It will be seen that the machine is capable of performing a great variety of work, and is well adapted for general shop use.—*Industries.*



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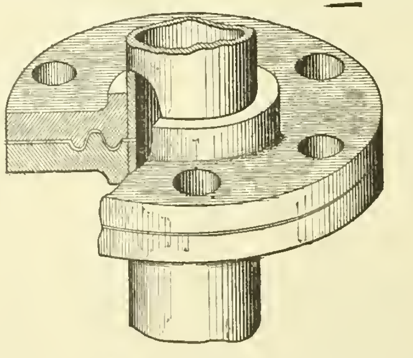
NEW FLANGE JOINT.

A new form of flange has been devised in England, which is adapted to high pressures. It is shown in the engraving herewith so clearly that nothing further is needed in explanation. The grooves are turned in the face of the flange and fit closely without a joint between them.



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Friends will observe by our club rate list, that we make a reduction of 50 cents on each name where ten subscribe at one time, and give one copy free one year to the person sending the club. It is a good time to begin now to get ten names.

THE RISKS THEY TAKE.

A steamer of 10,000 tons, going at the rate of 20 knots per hour, would strike with an energy of about 40,000,000,000 foot-pounds, and there would not be enough of her left to make a horseshoe nail.

At present the great desire to lower the time of passage between Europe and America—to "break the record"—has a charm which few of the citizens of either hemisphere can resist.

Regardless of the danger to be encountered, and actuated by the desire to render a certain line, or even a particular ship, famous, masters will drive these splendid steamers through dense fog-banks, day and night, at a speed of 20 or 21 knots (24 or 25 miles) per hour, along a track known to be beset with thousands of dangers.

The great mass of travelers are ignorant of the fearful risks which surround them under such circumstances, and rest contented in the assurance that the greatest care will be taken. The vessel rushes madly along; well-trained eyes are continually strained to detect the first sign of danger, and all that can add to the security of the ship, so far as intelligence and watchfulness, on that course is being exercised; but that she does not collide with some of the icebergs, derelicts or other vessels along the route is, in many cases, to be ascribed to good luck rather than carefulness. It is impossible to exercise care at such a rate of speed in thick weather. Choosing the shortest line between the two ports, she adheres as strictly as possible to this course, just as though she were the only vessel upon the ocean, regardless of the fact that this is also the shortest line for all other vessels.

The result is that she possibly "breaks the record," and arrives off Sandy Hook in six minutes less time than some other vessel has previously done the distance, or—perhaps she strikes an iceberg or derelict, in which case nothing is left of vessel, passengers, or freight, except bills of lading, freight receipts, and insurance policies.—*Lieut. H. H. Barroll, U. S. N.*

◆

It has been computed as an illustration of the great cheapening of ocean freight which has taken place in recent years, that half a sheet of note paper will develop sufficient power, when burned in connection with the triple expansion engine, to carry a ton a mile in an Atlantic steamer.—*Marine Record.*

This is a fair example of the mauling a technical illustration gets at the hands of the non-technical press. It was shown, some five years ago, in this paper, that half an ounce of coal would carry a ton of freight one mile when triple expansion engines were used, and as a letter must weigh under half an ounce to go at single postage, it was stated that an average sheet of letter paper would do the work. Now our friends have got the amount down to half a sheet of note paper. Keep on, and we shall get something for nothing!

◆

"The cylinder castings have been very successful. Careful scrutiny fails to disclose the slightest flaw in the work. It must be borne in mind that this is the first set of cylinders cast at the Brooklyn yard, and for that reason the result is especially gratifying. The credit belongs wholly to Chief Engineer Dungan and the engineer officers of the navy acting under his instructions." —*Daily Paper.*

[Didn't the men that moulded the cylinders have anything to do with it? Credit where credit is due.]

◆

In former years foreign papers have contained long reports of the English naval manœuvers. This year not a report appeared. A few articles were published citing very damaging facts as to the efficiency of the vaunted armor bearers, but there are no long reports. Doubtless the facts were so bad that the authorities suppressed them.

AMERICAN SHIPS THE BEST.

MR. A. U. SHELDON, who has been associated for several years with the large shipbuilding establishment of John Elder & Co., and more recently with the Vulcan Construction Works at Stettin, Germany, has been passing a few weeks in this country, to see how far we have advanced in modern shipbuilding.

"I had observed," he says, "in European industrial circles the opinion prevails that shipbuilding in iron and steel in the United States does not keep pace with the times, and was, on arriving in this country, agreeably surprised to find such opinion altogether erroneous, and that America does not only produce merchant vessels of the highest order, but also has within a few years created a really efficient fleet of modern war ships.

"Such a naval display as was lately seen in New York harbor on the occasion of transferring the body of the late John Ericsson to the cruiser '*Baltimore*' cannot fail to impress any one interested in these matters, and to give an idea of the vast resources of a country capable of producing in such a comparatively short time such astonishing results.

"There is no doubt that American merchant ships are, as a rule, of better proportions than European ones, especially as regards beam, and I trust that the dangerously narrow and shallow steamers which have for several years been built, chiefly on the east coast of England, may speedily give way to a more wholesome and satisfactory model.

◆

THE Mount Carmel Æronautic Manufacturing Company was recently chartered with a capital of $20,000,000. Within sixty days the first air ship is to arrive in Chicago. The company is backed by a powerful English syndicate and by Eastern capitalists. The incorporators, however, are the inventors, E. J. Pennington and Richard Butler, of the Mount Carmel Machine and Pulley Works, at Mount Carmel, Ill.; W. C. Dewey, of the Grand Rapids Furniture Manufacturing Company, of Grand Rapids, Mich.; E. L. Chamberlain, and James A. Pugh.

The proposed air ship, models of which have been successfully tested, will carry cars the size of Pullman cars, with accommodations for fifty persons each, special cars being manufactured for quick mail and passenger service. Work will commence immediately at Mount Carmel upon the manufactory. The plant will be a mammoth one, covering many acres. The first building to be erected will be 800 feet square, and the contracts for it have already been let. The company will manufacture from the raw material, even to the aluminum, of which the air ships will be almost entirely constructed.

[This is going at a great pace for a new enterprise.]

◆

THE *Western Machinist* breaks out fiercely in its last issue on this ancient item, thus:

> "We presume that every man, women and child in the United States knows by this time that the man who invented the return ball made a fortune out of it. And we presume further that every man, woman and child is thoroughly sick and tired of being told about it in the newspapers. Every time this hoary chestnut is revived, every paper—especially those interested in patents—must needs rehearse it over again. Now, we say we are glad the man made a fortune, and hope he is enjoying it at the present moment; but, if we are always and forever to be told about it, we shall wish he had never been born, or that the first returning ball had slain him."

Yes, but what does our friend mean by publishing this in the same issue:

> "In order to keep machinery from rusting, take one ounce of camphor, dissolve it in a pound of melted lard; take off the scum and mix as much fine black lead as will give it iron color. Clean the machinery and smear it with this mixture. After twenty-four hours, rub clean with soft linen cloth. It will keep clean for months under ordinary circumstances."

Verily, this is an antique of the first water, and existed, no doubt, in 470 B. C.

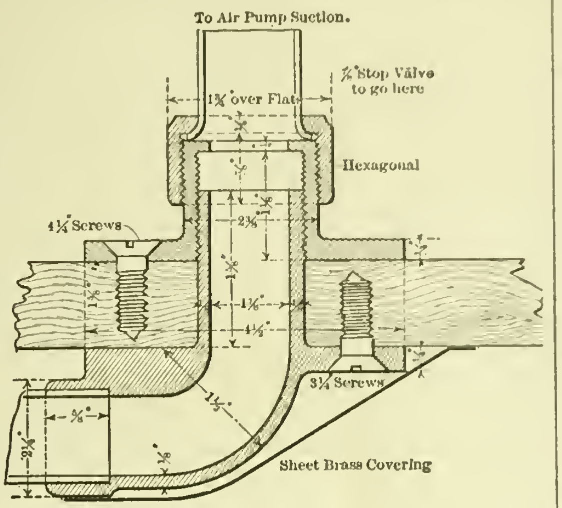
COMPOUND STEAM LAUNCH ENGINE

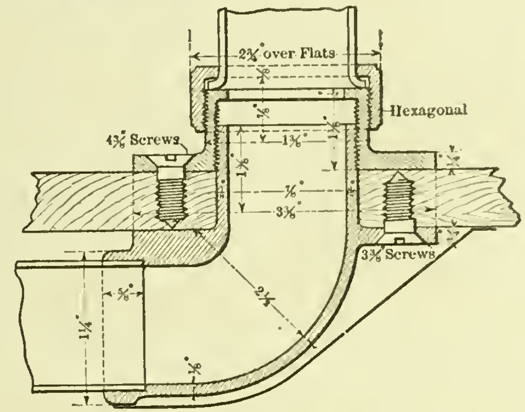
No. 8.

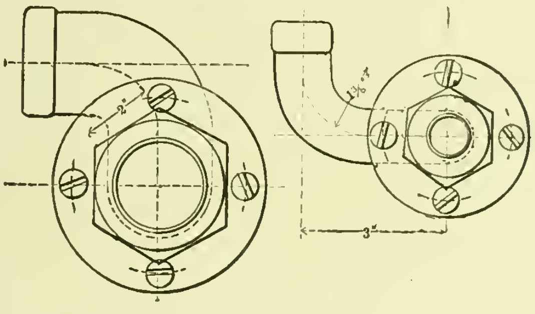
By the Bureau of Steam Engineering, U. S. N.

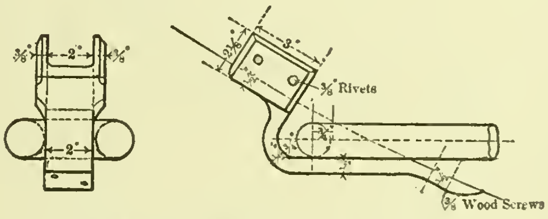
(*Concluded.*)

THE engravings in this issue show all the connections to condenser, and after bracket for condenser, which had to be omitted in the last issue. This closes the series of details, and though the engines are rather light for hard, continuous work, they will be found admirably adapted for small high speed pleasure boats. We can send the complete series of these drawings on one sheet for $2.









BRACKET FOR AFTER END OF CONDENSER.
(To be made from Templet.)

◆

No submarine boat has yet been made which is reliable or wholly practicable. The '*Goubet*' and her prototype, the Spanish boat '*Peral*,' seemed fully to come up to the essentials laid down for a submarine boat, including invisibility. Yet lately a board of naval experts, appointed by the Spanish Government to survey the Spanish boat, recommended that no more of this kind be built. All the successes of submarine boats seem to be in the reporters' accounts of them. The facts against them are never told.

◆

FRIENDS will observe by our club rate list, that we make a reduction of 50 cents on each name where ten subscribe at one time, and give one copy free one year to the person sending the club. It is a good time to begin now to get ten names.

THERE is a bill before the House of Representatives to regulate the salaries of the United States Local Inspectors of Steam Vessels, in proportion to the number of vessels inspected in their district; in districts inspecting less than one hundred steamers the inspectors to receive a salary of $1,200, while in a district inspecting five hundred steamers they are to receive $2,500 per year. Inspectors should be appointed for their ability to carry out laws, the most important of which is the inspection of boilers. And we cannot understand why a Mobile boiler inspector should not be as competent a man as a New York boiler inspector. Why should the former receive any less salary than the latter? Boiler inspectors should all be equally competent. Then why not receive equal pay? More steamers to inspect does not increase the hours of labor. As a rule, they come at nine in the morning and go at four in the afternoon. As the steamers increase, additional assistants are appointed; hence, their work becomes no harder. Experts only should hold the position of inspectors of steam vessels, and should be equally paid for their services.—*Marine Journal.*

◆

THE '*City of New York*' Ss. and '*City of Paris*,' Ss., are identical in power and model, yet one is faster than the other; the same is true of the '*Teutonic*' and the '*Majestic*;' they are sister ships, but they are not alike in performance. The explanation is to be found in the fact that the ships, although nonimally identical, are not so actually. They vary in degree, but not in kind. It is not possible to build two vessels exactly alike, even though the same molds be used. The frames will not be fac-similes in both ships and the plating will vary. Also, the engines do not perform equally well on both ships. It is currently reported that the '*City of New York*' has never exceeded 18,000 h.p., while the '*City of Paris*' has shown over 20,000 h.p. Again, screws vary in pitch and run over or under their nominal pitches, so that, even if the engines make the same number of revolutions, the screw does not travel so far in one instance as another. Slip also varies in screws of the same general dimensions, so that it is not within the bounds of probabillity that ships of the same lines and same nominal power will be of equal speed.

◆

FROM time to time we record the results of an experience in engineering in one way and another, and are grieved to see that persons in various part of the country disagree with us. Well, we do not know what is to be done about it. We fear that we shall have to let them find out, as all others do, by experience; that is, when they are in the way of getting any. We are very glad to learn from all sources, and manage to acquire more or less information from the experience of others, but we venture to say that persons who have never had any experience whatever, have little or no information to impart to others.

◆

THE range and penetrating power of modern rifles are tremendous. The six-inch American rifle will drive its projectile through ten and a half inches of wrought-iron a thousand yards from the muzzle. The eight-inch rifle will pierce sixteen and three-tenths inches of iron at the same distance. The ten-inch rifle that the '*Miantonomoh*' will carry will pierce twenty-one inches of iron a thousand yards away. The twelve-inch rifle will penetrate twenty-eight inches of iron at a range of three thousand feet.

◆

IT has been said that inventors have no business ability; perhaps they have not, as a class, but as individuals they have, otherwise it is difficult to account for the various useless schemes which are floated. The inventor must have had ability enough to get some one interested in them, otherwise they would not appear in the broad light of day.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

GRATE SURFACE IS TOO SMALL.

Editors Engineer:

There is a flat place or depression in the bottom of my boiler, and I would like to know if it will do any harm? It is about 4"×6", and nearly $\frac{1}{16}$" deep. I sounded it with a hammer, and it seems all right. The boiler is 44" diam. by 16' long, and has 36 tubes 3½" diam. The grate surface is 13 square feet. Is the boiler large enough for a 44 h.p. engine?

Slater, Mo. W. D. Joslin.

[The heating surface is ample, being 550 square feet if set in the usual way, but the grate surface is much too small, being in the ratio of 1 to 42, when it should be at least 1 to 30. If the boiler is set as usual it would be easy to set the bridge wall further back, say one foot, and get new grate bars one foot longer. This would make the present heating surface more efficient by burning more coal under it. If the dent, so-called, is inward, toward the inside of the boiler, it is of no consequence, and may have been done when the boiler was built. If the plate is bulged outward, it is caused by scale or grease getting inside on the sheet and wants attention.—Eds.]

◆

MARINE ENGINEERS' BENEFICIAL ASSOCIATION, No. 82, BATH, ME.

Editors Engineer:

There has just been instituted here the Kennebec Marine Engineers' Beneficial Association, No. 82. We now have thirty charter members, and our prospects here are good for a large Order. The officers are: Robert Shea, P. Pres.; R. C. Gackenback, Pres.; H. C. Shea, Vice-Pres.; T. H. Gawell, Treasurer and Financial Secretary; V. D. Mitchell, Rec. and Corresponding Secretary; W. H. Shea, Chaplain; J. H. Hughes, Conductor; T. Farnham, Doorkeeper; Trustees—James Simson, F. C. Vass, C. E. Hatch. As many of us are readers of your valuable paper, we thought you would like to hear that the engineers are alive in the good work down in the "Pine Tree State."

V. D. Mitchell,
Bath, Me. Cor. Sec.

[The Kennebec, M. E. A., is welcome to the ranks of the Association, and we hope to meet her delegate at Washington, D. C., next January. There should be associations in every port in this country, and before many years there will be.—Eds.]

◆

A few days ago I was standing by an American gentleman, when I expressed a wish to know which point was the north. He at once pulled out his watch, looked at it, and pointed to the north. I asked him whether he had a compass attached to his watch. "All watches," he replied, "are compasses." Then he explained to me how this was. Point the hour hand to the sun and the south is exactly half way between the hour and the figure XII on the watch. For instance, suppose that it is 4 o'clock. Point the hand indicating 4 to the sun, and II on the watch is exactly south. Suppose that it is 8 o'clock, point the hand indicating 8 to the sun, and the figure X on the watch is due south. My American friend was quite surprised that I did not know this. Thinking that very possibly I was ignorant of a thing that everyone else knew, and happening to meet Mr. Stanley, I asked that eminent traveler whether he was aware of this simple mode of discovering the points of the compass. He said that he had never heard of it. I presume, therefore, that the world is in the same state of ignorance.—*London Truth.*

◆

Electric cars are, it seems, liable to be burned up at short notice. A car of the electric street railway in Meriden, Conn., became short circuited and took fire. The car was filled with passengers, a number of whom were girls on their way home from school, and in a moment a panic seized them, and their screams as they tried to escape from the car could be heard several blocks. One of the doors became fastened and could not be opened, but all finally escaped.

◆

We want canvassers in all parts to solicit subscribers, and will pay cash to all who can undertake the task. It should not be difficult to earn $30 in a short time with this paper. Send for our circular.

AMERICAN STEAM YACHTS.

Steam yachting is always referred to as a pleasure in which only men of money can indulge. It is an expensive luxury, considered from the point of view of the majority of steam yachtsmen, although the cost of building and maintaining a steam or naphtha launch, in which a man can have no end of fun, is comparatively small. However, the pleasure to be found in the possession of a launch is mainly confined to smooth waters, and usually lasts as long as the sun shines, while real comfort is to be found only on such craft as are owned by wealthy men.

In a large steam yacht the ideas of comfort and luxury predominate, the element of contest showing itself in only a few instances.

Nowadays, when speed is the especial object sought in a yacht, other advantageous features are abandoned, and so it is that the comfort of the owner is first considered and then the speed of the craft adjusted to meet certain requirements. If, for instance, the builders were given an order for a craft to make twenty knots, they would build a very different sort of boat than if instructed to design a yacht having large cabin accommodations and plenty of deck room, the speed to be as great as these characteristics would allow economically. In a steam yacht a man wants a good all-around boat, easy in a seaway, and provided with all the comforts of a home, while in contracting for a sloop or a cutter he sacrifices everything to speed. The efforts of the American Yacht Club—the great steam yachting club of the country—during the last two yachting seasons have demonstrated the antipathy of steam yacht owners to racing, although at the same time, as a class, they are enthusiastic over the sailing races of the various clubs, and turn out in force at the annual cruise of the New York Yacht Club.

The club book of this club contains the names of seventy-six steam yachts, including all the larger ones, except Jay Gould's '*Atalanta*,' an iron steamer with three masts, schooner-rigged. She is 248 feet 3 inches over all, 230 feet 3 inches on the water line, 26 feet 4 inches beam, and 13 feet draught.

The fleet of larger boats began in 1880 with the '*Radha*,' '*Corsair*,' '*Stranger*,' and '*Tillie*.' In 1882 were built the '*Orienta*' and '*Empress*.' Next came the '*Oneida*' and '*Meteor*'; in 1884 the '*Electra*,' '*Lagonda*,' and '*Nourmahal*' made their appearance, and the '*Wanda*' followed in another season. Then, in 1886, the already large fleet was graced by the '*Alva*,' '*Fedalma*,' and '*Reva*,' to be followed by the '*Neaira*,' '*Narwhal*,' and '*Susquehanna*' in 1887, the '*Sagamore*' and *Unquowa*' in 1888, the '*Elfrida*' in 1889, and the '*Alicia*,' '*Almy*,' '*Nydia*,' and '*Sultana*' this year. Of the four latter, Hadren & Robins, of Brooklyn, built the '*Sultana*,' the Harlan & Hollingsworth Company built the '*Alicia*' and '*Almy*,' and H. C. Wintringham, of Bay Ridge, turned out the '*Nydia*.' Two orders for steam yachts have been given J. Beavor Webb for next year. The prospective owners are understood to be W. W. Durant and J. Hood Wright, with Drexel, Morgan & Co. Others are talked of.

The New York Yacht Club's fleet of seventy-six steamers is estimated to be worth about $7,000,000. It is, of course, impossible to give any definite idea of the cost of running this fleet, but it has been frequently said that Commodore Gerry of the New York Yacht Club spends over $30,000 a year on the '*Electra*.'

The '*Electra*' is Commodore Gerry's summer home. He always has her within easy call and keeps her in the best possible condition. With her electric engine, 150 incandescent lights, electric headlight of 15,000 candle power, electric apparatus for firing the guns in starting regattas, ice machine capable of making fifty pounds daily, and, in fact, every modern convenience, the '*Electra*' is about as complete as could be desired. The cost of the salaries and board of her crew alone is about $1,000 a month.

Of course the '*Electra*' is an extreme illustration, but any one of the big boats takes enough money to put them beyond the reach of all except the very rich. Still, steam yachting is becoming more popular every year, backed up, as it is, by wealthy men whose individuality in their love of yachting seems to be their ambition to get to a place when they start for it, and not be subject to the capriciousness of the elements. There is no real love of yachting displayed by the steamboat men, but rather a fondness for an outing occasionally under such circumstances as will enable them to avoid the inconveniences of public travel, and have in their stead an enviable halo of comfortable luxuries. The fleet of steamers of the New York Yacht Club is as follows:

Name.	*Owner.*	*Port.*	*Water-line Length. Ft.*	*In.*
Adela	C. F. Kerr	New York	49	06
Adelita	N. C. Nash	Boston	87	00
Aida	W. P. Douglas	New York	90	00
Alicia	H. M. Flagler	New York	160	00
Almy	Frederic Gallatin	New York	155	06
Alva	W. K. Vanderbilt	New York	252	00
Avenel	J. H. Hanan	New Xork	106	00
Bo Peep	F. A. Constable & E. H. Weatherbee	New York	58	00
Calarina	E. D. Morgan	New York	170	00
Clara	Charles Kellogg	Philadelphia	92	00
Corsair	J. Pierpont Morgan	New York	165	00
Cosette	C. C. Worthington	New York	81	01
Dido	F. F. Chrystie	New York	55	00
Electra	E. T. Gerry	New York	162	02
Elfrida	W. S. Webb	New York	102	00
Empress	F. A. Schermerhorn	New York	100	03
Emu	E. Du Vivier	New York	77	07
Fedalma	E. M. Brown	New York	95	00
Fauvelle	E. Perignon	Havre	114	00
Haleyon	G. A. Bech	Po'keepsie	106	03
Inanda	E. M. Field	New York	87	08
Isolene	J. H. Flagler	New York	116	00
Jean	James Renwick	New York	90	00
Lagonda	S. H. Austin, Jr.	Philadelphia	118	00
Loando	T. H. French	New York	88	04
Lorna	G. C. Rand	New York	94	06
Lotus	G. G. Clark	Ogdensburg	82	00
Lucille	G. W. Vanderbilt	New York	64	00
Lurline	W. B. Wetmore	New York	86	09
Magnolia	Fairman Rogers	Philadelphia	96	00
Marguerite	W. H. Harriman	New York	78	06
Meteor	Archibald Watt	New York	140	00
Minnehaha	H. J. Barbey	Switzerland	60	00
Nautilus	H. M. Howe	Bristol	48	06
Nooya	Ph. Schuyler and J. L. Cadwallader	New York	98	00
Namouna	J. G. Bennett	New York	217	00
Norwhal	C. H. Osgood	Norwich	120	00
Neaira	Frederick Lovejoy	New York	115	00
Nereid	F. L. Osgood	Norwich	72	06
Nomad	Adrian Iselin, Jr.	New York	68	10
Nourmahal	William Astor	New York	221	00
Now Then	J. E. Addicks	Boston	85	00
Nydia	R. V. Pierce	Buffalo	82	06
Ocean Gem	W. H. Starbuck	New York	92	00
Ollie	Percy Chubb	New York	51	00
Oneida	E. C. Benedict	New York	121	06
Orienta	E. R. Ladew and J. H. Ladew	New York	117	00
Peerless	C. W. Harkness	New York	146	90
Radha	J. Burke Wolfe	New York	135	01
Restless	W. M. Singerly	Philadelphia	112	00
Reva	Pierre Lorillard	New York	135	00
Sagamore	W. A. Slater	Providence	160	00
Sappho	J. J. Alexandre	New York	83	00
Scionda	J. G. Saunders	Albany	86	00
Sereda	J. G. Bennett	Paris	70	00
Shenecosset	G. H. Watson	New London.		45
Sigma	S. C. Reynolds	Toledo	130	00
Skylark	A. M. Dodge	New York	94	03
Stella	H. E. Abbey	New York	56	03
Stranger	G. S. Scott	New York	165	00
Sunmaid	R. N. Laurie	London	60	00
Sultana	Trenor L. Park	New York	155	00
Susq'hanna	Joseph Stickney	New York	155	00
Theresa	J. M. Fiske	New York	90	00
Tillie	W. H. Starbuck	New York	157	00
Trophy	A. S. Barber	New York	88	00
Truant	T. H. Newberry	Detroit	74	00
Unquowa	O. B. Jennings	New York	115	00
Vedette	F. W. Vanderbilt	New York	104	00
Vision	Clarence McKim	New York	86	00
Vita	M. S. Smith	Detroit	84	00
Vivienne	J. L. Hutchinson	New York	109	00
Veto	J. Lorillard	New York	100	00
Viola	J. P. Kennedy	New York	63	00
Wamp'noag	H. L. Willoughby	Newport	58	00
Wanda	James Stillman	New York	127	00

—*N. Y. Times.*

◆

Our English contemporaries are rather sore at the result of the armor trials at Annapolis, when the English plate failed to give good results.

TRIAL TRIP OF THE 'PLYMOUTH,'

OF THE OLD COLONY STEAMBOAT COMPANY.

ON the first instant, the W. & A. Fletcher Company, of New York, took the new steamer '*Plymouth*' out for an engineer's trial run, to show the profession in this city what they have done with a new design of triple-cylinder expansion engine. In reality this is a quadruple cylinder engine, for there are two low-pressure cylinders, which were necessitated by the design, in order to harmonize the strains. These engines are below deck and largely below the water line; the boilers are also in the hold, so that the weights are all very low in the boat, which adds largely to her stability and ease of motion, a feature of value on some parts of her route.

The '*Plymouth*' runs between New York and Fall River, Mass., and is a magnificent specimen of an American passenger steamer of the very first-class. She is 366′ long over all, 50 feet beam (over the guards, 86 feet), and 21 feet deep at lowest point of sheer; her draught when loaded is 12 feet. She has a four-cylinder inclined engine, with two cylinders forward and two aft of the shaft; they are 47″ h.p., 75″ intermediáte, and two of $81\frac{1}{2}$ l.p., all 8 feet 3″ stroke.

The valves are of the balanced vertical puppet type on all cylinders, and on the high pressure cylinder an adjustable cut-off is used. The other cylinders have fixed Stevens' long toe cut-offs. The valves are worked by eccentrics through links, which are shifted by a special engine. Steam reverse gear is used, and the engines are easily governed by one hand from the main platform; they can be reversed at the drop of the hat. Each low pressure cylinder has its own air pump and surface condenser, with independent centrifugal circulating pump. The air pumps are vertical, 40 in. diameter and 30 in. stroke. The combined cooling surface of the condensers is 9,050 square feet. There are two independent duplex feed-pumps, the suction and discharge pipes of which are connected so that either are both can be used.

The wheels are of the feathering type, 30 feet in diameter. Each wheel has twelve curved steel buckets, $\frac{3}{8}$ inch thick, 4 feet wide, and 13 feet 3 inches long.

There are eight main boilers of the Scotch type, 11 feet 4 inches in diameter and 13 feet 1 inch long, made of $1\frac{1}{16}$th inch steel, in shell. There are two furnaces for each, of corrugated steel, made by the Continental Iron Works, Green Point, N. Y. Forced blast on the closed ash-pit system is used. The boilers have been tested to 260 pounds pressure, giving a working pressure of 170 pounds. The maximum pressure is 160 pounds. They are placed back to back in the vessel, two fire-rooms, one on each side of the hull. The coal descends through chutes by gravity to the fire-room, and ashes are discharged by ejectors. The smokestack is $10\frac{1}{2}$ feet in diameter and 86 feet above the water line.

The '*Plymouth*' is fitted with Blake pumps throughout, and these, for wrecking purposes, are on the main deck, driven by an independent donkey boiler of large size, The designer of the engines and boilers is Stevenson Taylor, vice-president and superintending engineer for the W. & A. Fletcher Company, and it was the universal opinion of the engineers assembled—who comprised leading men of wide experience—that Mr. Taylor had done himself great credit. The vessel has been hurried through to completion, and dispatch observed in all departments, but there were no evidences of hasty work in the engine-room, and the performance was all that could be expected of new engines of high power worked at high pressures. These last, however, were not used above 120 pounds on this trip, for reasons that are obvious to all engineers without explanation.

For a long time the engines were run at under 100 pounds pressure, and the revolutions varied from 20 to 24 when throttled. As the maximum required to develop the power—5,000 h.p.—is only 28 revs., it will be seen that the power realized when in good working order will be above that contracted for. The mechanical action of the engines was all that could be asked for. They were never stopped for adjustment of any kind in the six or seven hours' run, and not a pin was even hand-warm. The engine-room is large and very commodious. From the starting platform all the gauges can be seen on the left, and the figures are so large that they can be seen without a search light or spyglass. The main bearings are also within easy reach at all times, and as for the crank-pins they are under the hand. Mr. B. J. Benson is the chief engineer of the '*Plymouth*,' and will give a good account of her abilities.

A feature of great interest is the steering gear on the '*Plymouth*.' This is Sickles' patent, and is the most efficient one we ever saw. It is particularly adapted to passenger boats, for the reason that it is noiseless. This is the fact; turning one's back upon it the only sound which can be heard is the creaking of the tiller ropes as they wind around the winch. The engines themselves make no noise whatever. There are no gears of any kind, simply two inclined steam cylinders, one on either side, which turn a winch on which are the lines running to the rudder. A small wheel in the pilot house connects with the reversing gear of the engines (which is of a peculiar character), and there we have it—the most complete steam steerer in the market. The wheel can be put from hard over to hard over in no time at all; in fact the rudder is as quickly handled as a small boat's.

Taken all in all, the '*Plymouth*' is one of the finest steamboats of the day, which is saying a good deal when there are so many coming out. She readily made 18 to 20 miles on her first trial and with little over half power, and she will exceed this in regular service. The W. & A. Fletcher Company were contractors for the entire vessel ready for service.

◆

COMPOUND LOCOMOTIVES.

THE Baldwin Locomotive Works has issued a pamphlet containing the results of the extended experiments made by George H. Barrus, of Boston, this year, of the four-cylinder compound, and a simple locomotive on the Baltimore & Ohio road.

The two locomotives were built for the Baltimore & Ohio, and are in regular service. They are both comparatively new. Both are standard passenger engines and duplicates in every respect, except as to type.

The average consumption of coal for four round trips between Philadelphia and Washington was 14.9 per cent. less in the compound than in the standard engine; and the consumption of steam per horse-power per hour during the selected periods of the runs which have been analyzed was 5.5 per cent. less in the compound engine than in the standard.

The compound engine is more economical in the use of steam when running at slow speeds than at high speeds. The steam consumed when running at a speed of 257 revolutions per minute (50.4 miles per hour) was 25.69 lbs. per indicated h. p per hour, while that at a speed of 176 revolutions per minute (34.5 miles per hour) was 20.86 lbs. per indicated h.p. per hour, a difference of 19 per cent.

The tests furnish ample reason to expect a saving of not less than 30 per cent. on freight trains and on accommodation passenger trains making frequent stops.

The compound steams freely, and without undue exertion on the part of the fireman. It starts from a state of rest quite as promptly as the standard engine. No difficulty is encountered in moving the fastest trains on schedule time and in making up a reasonable amount of lost time.

Commenting on this, M. W. Forney says:

The most important fact brought out in these experiments was that, in two runs from Philadelphia to Washington and return, a distance of 266 miles, one of them by the compound locomotive, and the other by an ordinary engine of substantially the same design and dimensions, excepting the cylinders, the compound engine burned 14.9 per cent. less coal than the ordinary engine. Assuming that this truly represents the economy of the compound engine over the simple one, is it sufficient to warrant the use of the former type of locomotive instead of the latter? If coal costs from $1 to $1.50 per ton, a locomotive will burn from $1,500 to $2,500 worth in a year. Calling the saving by the use of compound engines 15 per cent., it would amount to from $225 to $375 per year. As an offset to this there would be the interest on the extra cost of the compound, which is about $500. Ten per cent., which any prudent business man would charge on this, would be $50, so that the saving will be reduced to from $175 to $325.

Another important consideration in this connection is the endurance of compound locomotives—that is, can you get as many days' or miles' service in a year out of a compound engine with four cylinders and some additional complication in the valve-gear and steam-pipes as a simple engine will give? Laying up a locomotive when it is badly needed is very expensive, and often results in serious loss to a railroad company. Will the economy stated compensate for the risk of a loss of service, to say nothing of some additional cost of repairs?

But even the economy reported seems to doubtful. The only comparison of the performance of the two engines in the report before us, which it seems possible to make, is that of the two runs with the Washington limited express. The curious fact appears in this that the boiler of the compound engine evaporated 6.06 lbs. of coal per pound of water, while the simple engine evaporated only 5.37 lbs. It is also reported that the compound consumed 84,506 lbs. of water in making the round trip, and the other engine consumed 88,040 lbs. Obviously, then, it took 88,040 lbs. of steam to do the work in the simple engine that was done by 84,506 lbs. in the compound. If the boiler of the simple engine had generated steam as economically as that of the compound—that is, if it had evaporated 6.06 lbs. of water per pound of coal instead of only 5.37 lbs., then the simple engine would have consumed only 14,528 lbs. of coal instead of 16,389 lbs., the actual consumption. As the compound engine burned 13,942 lbs., the difference in its favor would then have been only $4\frac{1}{4}$ per cent. In other words, the economy of the compound, from the report before us, seems to be due more to the boiler than to the engine.

◆

IN the annual report of the Zanesville, Ohio, water works, recently issued, there is a table published which is sufficient to astonish the unthinking who indulge freely in the water waste business. The table given gives various sizes and pipes, head and pressure, and commences with an aperture, the diameter of which is one sixty-fourth part of an inch, equivalent to that of a cambric needle. Under a head—we will say of 150 feet—equivalent to a pressure of almost 65 pounds to the square inch, the quantity of water which would escape during the year, if always open, would reach 26,280 gallons, or through an orifice the size of a pin, equal to one thirty-second of an inch, the quantity escaping in the same time and under the same pressure will be 115,632 gallons. Where so large a quantity as that will escape from a small orifice it is only a question of figures to ascertain how much water is lost through the winter months during the prevalence of frost.

◆

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150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK, OCT. 18, 1890. NO. 8.

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THE SMOKE NUISANCE.

THE furnace of a steam boiler is a crude gas retort which wastes more or less fuel, according to the skill with which it is managed. This naturally varies with the attendant. Under certain circumstances, with some types of boilers, it is possible to obtain very high evaporation, as is shown during tests of boilers, when the fires are managed with great skill and care as regards the admission of air, supply of fuel, and the subsequent burning of the same. Under haphazard attendance the same boilers lose a quarter, and in some cases one-third, of their capacity. What is termed combustion, or the burning of any fuel to ashes without loss, is a very well-known process, and with the proper apparatus will always produce similar results, but combustion or burning of fuel in this manner is in a certain sense a laboratory experiment, and can only be carried out successfully with careful attention and plenty of time. It is a very different process from effecting combustion, so called, in a steam boiler furnace, where the conditions to success are of necessity wanting. Time is lacking, for one thing, and the proper measurement or regulation of the quantity of air passing through the fire for another, and as these are essentials, complete or thorough combustion cannot be carried out in the ordinary furnace with all types of boilers.

Approximately, good combustion of fuel is the best that can be obtained, and even this only at the cost of watchfulness and patience not possible in the ordinary operation of a fire room.

Coal used for fuel is a combination of gases and solids, the latter being carbon, earthy matter, various minerals that are shut up in it, and water. All of these substances are combined in one concrete form. Some of them are combustible and some are not; all of them burn at different temperatures and in varying volumes. The gases particularly are inert, unless they form chemical unions in special volumes. They vary also in weight, and when we understand these facts it is very easy to see that burning coal under a steam boiler economically is by no means a simple matter, but one that calls for the highest intelligence and trained observation if we would be successful. The usual way of burning coal is to throw it bodily on the top of other fuel which may be there. The immediate result is the dissipation of the moisture on the surface of it, combined with the external dust and the gases which are expelled. These unite in one cloud and issue from the chimney as smoke. A small portion of this is combustible under certain limits, which, let us say, seldom or never occur in a boiler furnace. The watery vapor or envelope is not combustible. The gases are not combustible as they are given off, for the reason that they do not ignite even, much less burn (ignition is not burning by any means), unless they are chemically mixed in certain volumes, with a given quantity of air at certain temperatures. It is very easy to see that these results cannot be reached, as we have said, in a boiler furnace, for not only is the union of the gases wholly mechanical, but they cannot be segregated or kept by themselves in certain quantities, and the exact quantity of air cannot be admitted. Moreover, these gases are constantly on their way out of the boiler, and constantly changing, one before the other, or intermingled with non-combustibles. The result is smoke, which, notwithstanding the statements of interested inventors of special apparatus for the purpose of burning; it cannot be burned.

Persons who think that smoke *per se* can be burned are invited to catch a quantity of it in a retort, heat the same to any temperature required and then try to burn it, in the sense of raising the temperature of a given quantity of water by the use of the smoke alone. The result will be a failure for the reasons set forth.

Smoke burning is impossible, but smoke prevention is not. This latter is best achieved by a careful well-paid fireman, who prevents the making of smoke by slow firing, as it may be called. If a shovel full of bituminous coal is thrown over the surface of an incandescent, coked, soft-coal fire, the result is a puff only of smoke, but the volume of it, as compared with the volume of heated gases constantly given off by the glowing fire, is so small that the smoke-puff is submerged, as it were, and does not appear at the chimney top. This process of firing is laborious but it is effectual; it causes a man to be opening and shutting the fire doors every minute or more, and keeps him on his feet constantly, so it is unpopular, and seldom if ever practiced. Another method of using soft coal with little or no smoke is to coke it on the dead plate before it is fired, or actually thrown on the surface. The green coal is thrown into the mouth of the furnace in front of the fire, which roasts the portion near the live fire. Of course smoke arises from it, but, as in the case of light firing, the smoke traverses the glowing coked fire; before it gets to the chimney it is a very light brown cloud, if not wholly dissipated. As fast as the coal is roasted it is shoved over on the fire, and this method is far more economical and satisfactory, as to the end desired, than any "smoke burner" so called. These last in most cases accomplish their end of preventing visible smoke by air-washing, so to call it. That is to say, the volume of air admitted is far in excess of that required. When this occurs carbonic acid is changed to carbonic oxide, which is a dead loss to the coal buyer; but we do not pursue this branch of the subject because we have purposely avoided dealing with gases by name, in this article. We do not wish to be pedantic but practical. The whole process of combustion can be consulted in many works where it is thoroughly discussed.

Smoke is caused by carelessness in nine cases out of ten, especially profuse smoke. When we see chimneys vomiting dense clouds of black smoke we know just as well as if we had been behind the man (many a time we have been the man ourselves) what has caused it. The furnace has been filled chock-a-block so to speak, and the fireman is resting from his labor and smoking himself. Where mechanical "smoke burners," so called, are used, the amount of fuel required for a given evaporation is increased for the reason that the temperature is decreased by the excess of air admitted.

STANDARD STEAM ENGINE CONSTRUCTION.

DRIVING fans for blowing fires is the hardest work a steam engine can do. There is a dead, steady drag on the crank-pin from first to last, without intermission so long as the engine runs, and as blowing engines run at high speeds they must be well made and well proportioned for the work. Perhaps we ought to qualify the above by saying it is the hardest work in our experience, for electric light engines do very similar work in driving dynamos. We have, however, never driven any of these last and can only speak in a general way as to the similarity. Now, electric light engines have been known to run for months without let up or cessation, but fan engines seldom run more than 24 hours without some relief. Be this as it may, an engine which can run 24 hours without relief can run 24 days, so far as heating of bearings is concerned, provided attention is given to it. The point of our remarks is that these engines which show so much endurance are all of different proportions, as regards their dimensions and details. No two of them are alike, unless it came about by chance. The parts vary, the valves vary, the valve gear varies, the governors are not the same; the very flywheels vary in dimension and weight. It is a point with the designers to have their engines vary, otherwise they are at once accused of copying from one another. Now, the engines being different in dimension and detail, where does "standard practice" come in which we hear so much about? There cannot be several standards.

Returning to blowing engines: we had several years ago, a pair under our charge on a steamer. They were 14″ diameter × 12″ piston stroke, and drove three 6′ fans at as a high a speed as they could be driven. They were driven as hard as they could go, and made from 200 to 250 revolutions per minute, for say sixteen to twenty hours on a stretch. The crank-pins of these engines were $2\frac{1}{2}$″ diameter by 3″ wide, and they never gave any trouble whatever from heating or undue wear. For months at a time they were never touched anywhere, and did good service. All they wanted was steam and oil, and away they went. Now, 250 revolutions is not as high a speed as some electric light engines run at, but it was sufficiently high to test the ability of a $2\frac{1}{2}$″ crank-pin for the work done, which was practically 100 h.p. in each engine, the dimensions being 14″ piston, 50 lbs. m.e.p., and 500 ft. per min., piston speed. If engines of a similar power were designed to-day for an electric light plant, the crank-pins would be an inch larger in diameter and on the face. In other words, they would vary materially.

The point of our argument is that there is no such thing as standard practice in building steam engines. If there was, there could only be one Corliss engine in the country, one electric light engine, and one engine for all sorts of purposes. If there existed a standard of practice then steam engine building would be greatly simplified, for we should have standard cylinder factories, making nothing but steam cylinders of the standard size and pattern. There could be standard crank-pin factories, making nothing but crank-pins, which would be turned out like clothes-pins from machines, and so on through every detail and appurtenance of a steam engine. Everyone knows that such factories as these would starve for want of patronage.

We repeat that there is no standard practice in building steam engines; what is more, there never will be. Men differ in their views, and until we can have a standard human mind and bring all men's ideas to one standard, there will be different kinds of steam engines in the market with wholly different dimensions for exactly the same work.

If there was a standard for steam engines we should need only one pocket book of rules and formulæ, but as there are very many pocket books with various formulæ it shows that men are not agreed upon a standard. Why are there so many pocket books? We do not know, unless it is that each engineer thinks he knows best how to make one.

There is a standard multiplication table, and there are standard arithmetical and algebraic processes; if we go aside from them we shall come to grief, profound and immediate, but there is no standard system of making a steam engine, for there are as many different ways of making them as there are leaves on some trees, and between the whole lot there is not any marked difference as to economy in the best grades. One has some one feature better than another, but none are perfect and none are standard in the sense that they cannot be departed from without loss or failure.

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Friends will observe by our club rate list, that we make a reduction of 50 cents on each name where ten subscribe at one time, and give one copy free one year to the person sending the club. It is a good time to begin now to get ten names.

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We are indebted to Angus Sinclair for a copy of the proceedings of the American Master Mechanics Association, a work which has great value for its technical discussions.

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Aluminum has been reduced to $1 a pound.

COMBINATIONS TO RAISE PRICES.

There is, we believe, a law existant which makes it a penal offense to artificially raise prices of commodities either in creating a scarcity by locking them up or by any other sort of trick and device. Such laws cannot be enforced, for there is no legal proof of the offense, and convictions would be impossible. Whether there is such a law or not, the evil it was intended to prevent is rampant. The "Trust Company" is as active to-day as ever and in one form or another has its will of the people.

"There is now but one axe company in the United States, the American Axe and Tool Company, at Pittsburg. This company has purchased outright every axe factory in the country of any importance, and by thus controlling the productions have advanced prices on an average of $2.00 a dozen. This company also control the manufacture of axe polls, (or the heads of axes,) the machinery for which is patented, and this enables them to keep the price on polls so high that no one else can afford to make axes."

"The same is true of saws, and to-day there are but two companies that manufacture hand saws where there were a dozen four months ago. Prices in this line of goods have been advanced from 10 to 40 per cent. In cross-cuts it is the same. By a consolidation of interests prices have been advanced from 4 to 8 cents a foot."

In other words, the big fish have eaten the little ones. We once held the view that sooner or later all trusts would fail from inherent weakness, but from the logic of events—that is, the continued existence of old trust companies and the formation of new ones of the same character—we are compelled to believe that there is nothing in the way of any persons who may have the ability to do so to form combinations to fix prices wholly independent of supply and demand.

NOTE UPON SLIDE VALVES.

If we need any assurance that the copy set for us when we were younger—"*Many men of many minds*"—is correct, we need only read the articles and discussions in technical papers, to see that there are truly a variety of opinions upon subjects which would seem to be so simple that there could be but one view of the matter. It sometimes happens that men read superficially, and are in haste to controvert when a review shows that both writers are in perfect accord. We read in a contemporary a discussion on balanced slide valves, and it records the results of an experiment made by a professor, which, if taken latterly, would seem to show that a slide valve could not be balanced at all, perfectly. Facts, however, show that there are many slide valves in use which are balanced, to the extent, at least, that a great portion of the load is removed from them. Since this is very great on large valves at starting, it would seem surprising that balanced slide valves were not in general use. They are very far from that. There are other persons, again, who assert that the friction of a slide valve on an engine is very small indeed, when in full work, and a correspondent cited an experiment he made recently upon a vertical engine, which showed that the weight of the valve and gear attached was sufficient to bring it down; that is to say, one strap was removed from the eccentric, but the valve continued to work perfectly, the upper strap of the eccentric never leaving the wheel itself. This was a compound engine, and we do not know which cylinder the experiment was tried upon. Balanced slide valves are a great advantage in all respects, ease of handling, wear of seats, valves, and valve gear; but it would seem evident that when in full work the friction is much less than is supposed, for were it otherwise the link motion would not live so long as it does without repair. Considering the work done by it it is one of the most durable details of a steam engine.

WHAT CAN YOU DO?

The world is just as full of work to be done as it was when it was first created, and men are wanted to do it; but, if we may judge from the attitude of some who are just starting in life, the work is all done, and all that remains is to glean here and there. Other men have the "good places," and there is no chance for newcomers. If we reflect a little we see that these other men who are in good places had to go through exactly the same experience that newcomers, so called, have to endure. They were the newcomers once, but they are old timers now, and they have won their places and made more or less reputation for themselves by flying right at Hard Work and getting the best of it. The man who gets any reward at any stage of the world's progress is the one who works for it, head and hand, and there are as many chances for success now as there ever were. There are even more, for the world has more inhabitants yearly, all of whom have wants; new countries are opened up, civilization extends its borders, and in all these things there are opportunities for the ambitious. There is work to be done and men must do it, the only question being what particular kind of work individuals shall essay.

It behooves everyone starting in life to ask himself what he can do best. The business for which he has a natural aptitude or liking is in most cases the best, but this is not absolutely correct in all cases. A young man must ask himself what he can do, and when he finds out, do that one thing better than than some one else can. Treatises have been written, and great men interviewed upon the subject of success in life; how shall young men proceed to become wealthy and wise? Some say go this way, others say go that, but the advice given must all be accompanied by a determination to work if any good is to come of it.

The daily papers are full of advertisements of men who want places to do anything—Useful Man, they are generally headed, and of all misnomers this is the most striking. The useful man, so called, is usually the most worthless of his tribe. He can do nothing thoroughly. If he sweeps he leaves half the litter behind him, and all his efforts are half-hearted, and his work half done. The useful man is one who has let his youth pass in uncertainties as to what he shall do. Dislike of hard work is a prominent failing, and he usually ends his career "unwept, unhonored, and unsung." Timely hints and good counsel are of service to young men, but unless they couple these with a determination to win by hard work they certainly will end as "useful men."

TWENTY-FIVE DOLLARS FOR YOU.

For the best article on the practical management of the Corliss engine in all details, either high or low-pressure, we will pay the sum of twenty-five dollars. The competition is limited to persons actually in charge of plants, and must be specific in detail, including management of boiler, the fires, quality of fuel used, and the amount of the same. Indicator cards should accompany the article, and the kind of work done should be specified; also how long the engine has been at work. The article will not be needed before November 25, but may come as soon as it can be written. The articles will be judged wholly upon their merits as practical essays, not at all for their literary qualities. We will do all work of this kind needed upon articles which are valuable. The matter must be strictly original with the writer of it and within his own experience: He must also be a subscriber to this paper. We hope to have many submitted, but as only one can be accepted it will be necessary to enclose stamps if the M S. is to be returned.

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We are paying good rates to persons to canvass for The Engineer and will send circular upon application.

Foreign and Domestic Trade Literature.

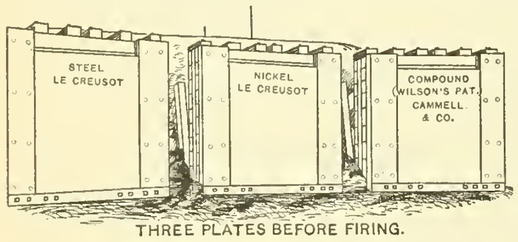
THE ANNAPOLIS ARMOR TRIAL.

THE tests of armor begun at the naval ordnance proving grounds under the supervision of Commodore Folger, Chief of Ordnance, on the 18th of September, and continued and concluded on the 22d, were not only by far the most important ever held in this country, but were among the severest ever made anywhere in the long contest for supremacy between target and gun. The extent of the victory won by nickel-steel in this trial can be best shown by the illustrations herewith presented of the rival plates as they appeared at the end of the competition.

The plates tested were a compound plate, having a hard steel face and wrought-iron back, made by Charles Cammell & Co. of Sheffield; a forged steel plate made by Schneider & Co. of Le Creusot; finally, a plate also from Le Creusot, made from an alloy of steel with about 3¼ or 3½ per cent. of nickel.

Lieutenant W. H. Jaques, formerly of our navy, and now of the Bethlehem Iron Works, gives this description of the mode of manufacturing compound plates by Cammell and Brown:

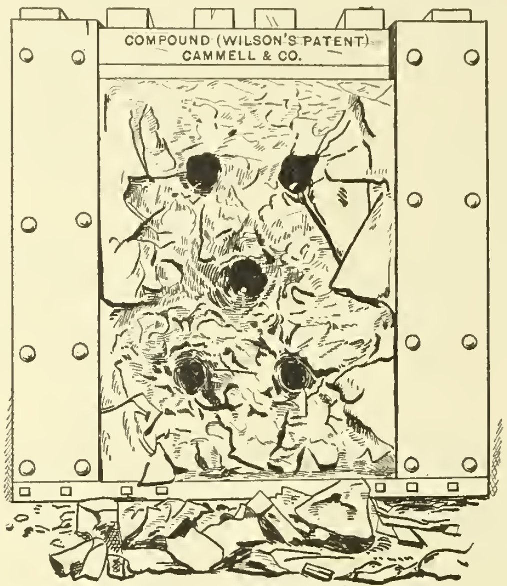
> "The iron back is made by the ordinary method of manufacturing wrought-iron plates, and is common to the two establishments. The method at present employed by Brown is to lay the forged steel face plate over the wrought-iron plate, from which it is separated by a wedge frame round three sides and rows of steel blocks called distance pieces. Thus prepared, they are carried to the heating furnace, where, after covering all exposed steel surfaces with gannister, they are raised to the proper temperature and transferred to a vertical iron pit, where a hydraulic ram holds all the parts securely and prevents the bulging of the face plate. Molten steel, either Bessemer or open hearth, is then poured into the space between the plates, and after sufficient time has been allowed for it to solidify, the whole is placed in a hydraulic press of 6,000 tons' capacity, and the thickness reduced about three inches. The plate is then finished by reheating, passing through the rolls, bending, planing and fitting it for the service required. Cammell heats the wrought-iron plate to the required temperature and rolls it into an iron mould that works on trunnions. The mould is then lifted by a crane to a vertical position and landed into a pit, where it receives the open hearth or Bessemer steel which is to constitute the hard face. After solidifying, the plate is finished in the rolls. Two-thirds iron and one-third steel are still accepted as the best proportions. Both methods give practically the same results under fire."



THREE PLATES BEFORE FIRING.

The most famous producers of steel armor are Schneider & Co., of Le Creusot, in France, while in England Whitworth and others are well known. Lieut. Jaques says of Schneider & Co., that "besides possessing methods of composition, tempering, and annealing, and treatment generally, which no one has been able to equal, they have a valuable experience that enables them to rapidly increase the efficiency of their production." This last assertion has now been strikingly verified. In manufacturing compound plates one difficulty is that of joining the iron and steel, whereas a Schneider plate is a single ingot of homogeneous metal. These ingots, according to Rear-Admiral Simpson, of our navy, "are cast nearly cubical in form. An ingot of seventy-five tons is usually heated about eight times before being reduced to its final shape, after which the edges are cut off with powerful tools." According to Lieut. Jaques, the difference of object in the two systems may be described as follows: "The steel face of compound armor contains about 0.7 per cent. of carbon, and its object is to deform or break up the projectile on impact, while the wrought-iron back holds the plate together and keeps the steel up to its work; the iron back is not expected to be of much value in keeping out the shot after it has penetrated the steel face. Major Mackinley, R. A., thinks that compound armor has an advantage because its face is so hard, but considers that the union of the two materials, steel and wrought-iron, probably leads to complication and uncertainty in results.

"Schneider steel armor contains about 0.4 per cent. of carbon, and is very carefully tempered. The outer surface of the plate is slightly harder than the inner surface, and the object to be obtained is not only to destroy the shot on impact, but to present as great and nearly uniform a resistance as possible throughout the entire thickness of the plate, so that it may hold together till the shot is broken.



COMPOUND PLATE AFTER FIVE SHOTS.

"Compound armor, therefore, shows to better advantage, so far as a surface work is concerned, when the projectiles are poor than when they are good."

It only remains to speak of the third plate, the one containing an alloy of nickel. The possibility of obtaining greater tenacity from such an admixture has been a subject of study and experiment in Europe for two or three years. Schneider & Co. found that the tensile tests in certain combinations of nickel with steel were very satisfactory, and it is said that the ballistic tests with small plates yielded promising results. But no nickel steel plate of the size used at Annapolis had ever before been subjected to a public competitive trial. It is said that the alloy of nickel in the successful plate is 3.24, with very much smaller percentages of carbon, silicon, and of manganese; but there is no official statement on this point.

The three plates were each 8 feet high by 6 feet wide, the two Schneiders being 10.5 inches thick and the Cammell 10.6 inches. They were bolted to 36 inches of oak backing, well braced with supports. The gun used on the first day was a 6-inch naval breech-loading rifle, specially constructed at the Washington Ordnance Factory for the purpose, and made about 1½ feet longer than the standard gun of this calibre, so as to secure a higher initial velocity. The charge was 44¼ pounds of American cocoa powder, which was estimated to give a muzzle velocity of 2,075 feet per second, and a muzzle energy of about 3,300 foot tons. At a trial against a similar Cammell plate last spring at Portsmouth, the initial velocity of the British 6-inch gun was but 1,976 feet, and the striking energy 2,800 foot tons. The projectiles used at Annapolis were Holtzer forged steel shells, made at Unieux, in France, 17 inches long and weighing 100 pounds each. The armor plates were ranged on the arc of a circle about thirty feet from the muzzle of the gun.

Twelve shots were fired. First came three aimed in succession at the lower right-hand corners of the three plates; then three at their lower left-hand corners; three more at the upper right-hand corners; while the final rounds were at the upper left-hand corners.

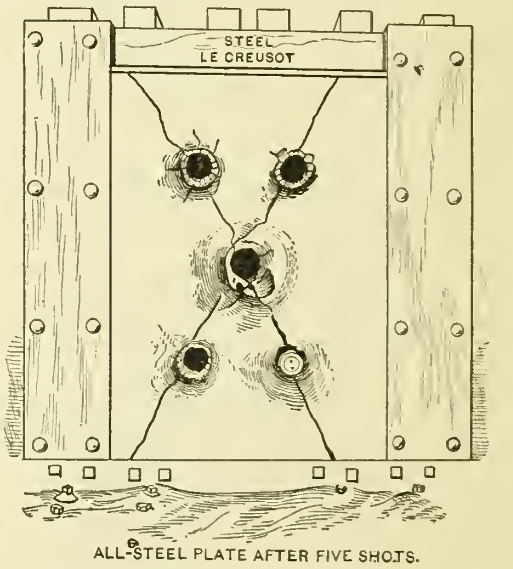
The first shot was at the Schneider all-steel plate. The projectile perforated the metal, and its point reached a few inches beyond into the backing, turning up a little ridge of surface metal around the orifice, but leaving the rest of the plate intact.

The next shot was at the Cammell compound plate. It went clean through the plate and was imbedded in the oak backing, the point of the shell having penetrated more than two feet into the backing. The plate was splintered around the hole, and seven cracks were visible.

The third shot was at the Schneider nickel-steel plate. The projectile was broken, and part of it flew back twenty-five feet. The point got through the plate and just entered the backing, as in the all-steel plate, and as in that also the only injury to the plate was immediately around the hole.

The second series of shots practically repeated and enforced the story of the first, and so it was with the third and fourth series. In each case the projectile was just about able to pierce the two Schneider plates, or perhaps to go a few inches into the backing, but in no case did either plate show cracks. In one instance the projectile rebounded from the all-steel plate and in another it was broken, while the nickel-steel plate broke two projectiles. But the Cammell plate suffered more and more from each shot. At the second shot the projectile broke, but the cracks previously showing as dark lines became open fissures, and many pieces of the steel face were torn off. The third shot set the backing on fire and showed a mass of deep cracks in the plate. The fourth shot dismantled the top of the plate, stripping off the steel face from the upper holes and going clear through the target, backing and all, the largest piece of the broken projectile being sunk in the hillside.

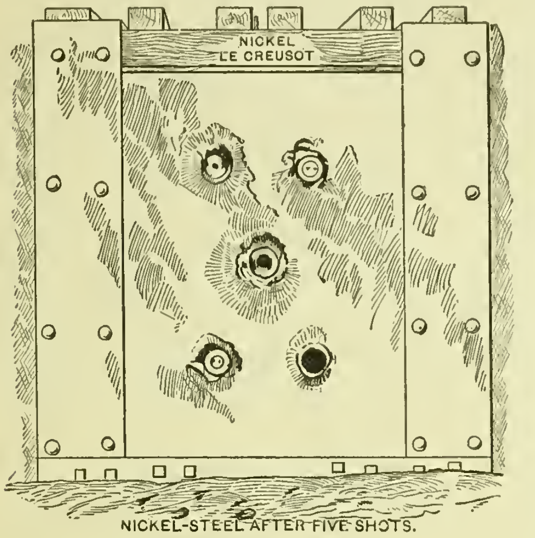
The first day's trial thus ended in the practical wreck of the compound plate and the triumph of the two steel plates, with the advantage rather in favor of the nickel steel, as showing less injury, although it had allowed a little greater penetration of the projectiles. Four days later the trial was resumed with an 8-inch naval breechloader, throwing a 210 pound shell, made by Firth of Sheffield on the Firminy process. Had a fifth shot been given instead by the 6-inch gun, it would have formed an ordinary test: as would have been only two shots with the 6-inch and one with the 8-inch gun. But the test was to be more exhaustive than had at first been intended. However, on account of the short range and the previous weakening of the plates, it was deemed prudent to use only 85 pounds of Dupont's brown prismatic powder in the 8-inch gun, which gave an initial velocity of but 1,850 feet.



ALL-STEEL PLATE AFTER FIVE SHOTS.

The first shot was fired at the center of the all-steel plate. The point of the projectile penetrated it and entered 4½ inches into the wood backing, then rebounded, broken into three nearly equal parts. The edges of the hole was splintered, and four cracks radiated from it through the holes made by the 6-inch shots and continued to the corners of the plate.

The second shot was fired at the center of the nickel-steel plate. The point of the projectile reached about 11 inches into the backing, but was badly broken up, about a third of it remaining in the plate. What was most important, there were no cracks anywhere, and the only injury was the ragged edge around the orifice. The third shot was at the compound plate, and inasmuch as it had already been nearly ruined, the projectile went clean through the plate, through three feet of oak backing also, through a part of one of the braces, and lodged unbroken 12 feet deep in the packed earth. Almost the entire face of the plate was gone, to the depth of 3 to 5 inches, irregular lumps clinging to the side supports. The wrought-iron back of the plate held its place against the oak, but it had of course offered little resistance. Fragments of steel flew long distances, and a mass of them dropped in front of the plate. Thus the trial ended in the victory of the nickel-steel. Save for the 8-inch shot, that victory would not have been so complete, since presumably the all-steel plate would have stood another 6-inch shot very well. The American guns appeared to great advantage, as did also the Holtzer projectile; but the Firth shells did less well. Congress showed its appreciation of the value of this trial by promptly authorizing the purchase of $1,000,000 worth of nickel ore and nickel matte, so as to permit the alloy of nickel in the steel plates to be made for our new ships. This can easily be done, since the Schneider process of making steel armor is the one used at the Bethlehem Iron Works in its large contract with the Government for our new navy.—*N. Y. Sun.*



NICKEL-STEEL AFTER FIVE SHOTS.

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It is well to be careful of giving offense to others by the dogmatic expression of opinions, for every one has a right to views of some kind; if they are not orthodox, or those held by the world at large, so much the worse for the individual. Sometimes, however, when people try to make us believe the world is a cube, or that water runs up hill, naturally a decided dissent is not out of place.

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A CHUCKLE-HEADED laborer on a railway line left a jack on the track in the way of an approaching train, and ditched it with the loss of many lives. The company are now paying $15,000 to $20,000 per day to settle the losses incurred, while many families are thrown into great distress. That is what one heedless act did. "Eternal vigilance is the price of safety."

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It is a very great satisfaction to receive a prompt answer to business communications; it is more than satisfaction, it is profit, for it disposes of the matter and leaves opportunity for other things.

THE PROCESSES OF STEAM IN ITS DEVELOPMENT OF POWER BY MEANS OF A STEAM ENGINE.*

By Chief Engineer B. F. Isherwood, U. S. N.

At the present stage of steam engineering the most important research as regards the use of steam in steam engines to produce continuous mechanical power is the investigation of the various processes of the steam from leaving the boiler to arriving in the condenser. No attempt, to my knowledge, has been made up to the present hour to ascertain the kind and value of these processes, to show the great influence they exercise on the potential and economic effect of the engine, and to determine in what direction and to what extent they affect the possibility of improvement. A knowledge of these processes will prevent a waste of effort in wrong directions, will prevent attempts to overcome imaginary difficulties while ignoring real ones, and will guide unerringly to all that is possible to be obtained, having regard to the limitations imposed by Nature, and to which art must accommodate its labors if success is to follow them. Steam engineering, like all branches of industry, has a two-fold aspect; it may be practiced as an art, or it may be studied as a science, but its perfection requires it to be considered as an art elucidated by science, and guided by the latter as far as practical and economic conditions will permit.

As an art, the designing and constructing of steam engines has been by a purely tentative process—very long, very uncertain, and very costly—brought to a high level; experience, with alternating success and failure, has been the blind guide under which the constructive instincts of a succession of engineers have blundered along until the successes of the present day have been achieved. But, although science has contributed nothing to the growth of the steam engine, it alone can explain its methods, point out the direction in which something more may be obtained, show the causes by which its operations are performed, demonstrate the limits to its progress, destroy false hopes, and give the ability to know when the utmost possible has been attained. It is retrospective and prospective; it not only illumines the path already passed over, like the stern lights of an advancing vessel, but, like the bow lights of the same vessel, it can show the way ahead with certainty and safety.

There is a very sufficient reason why science contributed nothing to the improvement, or rather to the proper understanding, of the steam engine. The requisite science applicable for that purpose did not exist until quite recently. Not until the experiments of Regnault and the discovery and correlation of the facts of thermo-dynamics into a consistent system, could a true theory of the steam engine be formed; and, until these researches were complete, all advances had to be made tentatively by groping in the dark. There had, besides, to be made many and accurate experiments on engines of different types, dimensions and regimen, the results of which were to be confirmatory or subversive of the theory. Thus, the steam engine furnishes the best and surest foundation for thermo-dynamics up to the present hour; and it furnishes, also, the clearest and completest illustrations for that science. The proper methods of experimenting, and of interpreting the results of the experiments, had also to be devised. In physical investigations, even of the simplest kind, the deductions of science cannot be accepted with confidence until they are verified by experiment: and still less could such deductions be received without the fullest experimental evidence in so complicated a case as that of the steam engine. Without the results of Regnault's experiments on steam, and without the principles and data of thermo-dynamics, the performance of the steam engine would still remain the mystery it previously was.

The steam engine has been termed an elastic-pressure engine and a heat engine, neither of which terms is philosophically correct, nor gives a clear apprehension of the real facts of the case. The force which urges the piston of a steam engine is not an elastic force of the nature of the elasticity of a spring or of caoutchouc. It is, on the contrary, a concussive force acting by the impact of distinct molecules of steam, as a volley of bullets fired from a mitrailleuse acts against a resisting surface. The steam molecules are material bullets of infinitesimal dimensions moving with high velocities, and endowed, consequently, with *vis viva* which must remain in them until imparted to other matter. Nor is the steam engine a heat engine in the popular sense of the word heat, for there is no such thing as heat as a distinct entity, and the term has meaning—apart from organic sensation--only when used as a synonym for molecular *vis viva*. The steam engine, considered in the concrete, is a mechanism for converting molecular *vis viva* into mass *vis viva*, the molecular *vis viva* being composed of the product of the number of steam molecules in use, the mass of each, and the square of their mean velocity. The mass *vis viva* is the useful or commercial load or resistance to be overcome, and is always more or less small fraction of the molecular *vis viva*, the remaining portion of the latter being expended in the processes which the steam undergoes from leaving the boiler to entering the condenser, and imparted to the condensing water, or, if the engine be a non-condensing one, escaping unused with the exhaust steam into the atmosphere. The greater the fraction which the mass *vis viva* is of the molecular *vis viva*, in the case of the steam engine, the greater is the economy with which the mass *vis viva* is obtained or the commercial work done; and this fraction is affected so largely by the mechanism itself and by the material of its construction, apart from the manner in which the steam is used, that no theory of the steam engine can be complete which does not include these effects, due purely to the mechanism and its matter.

By considering all the effects produced by steam in its passage through a steam engine as simply dynamical, resulting from a mechanical cause and identical with those produced by bodies in motion striking other bodies, a clear and intelligible idea is obtained of the operations, which is impossible by considering them as the effects of heat or of elasticity. As particular cases of *vis viva*, these effects are visible and tangible to the the mind, because, when the masses are large enough, the effects are visible and tangible to the senses, and what is true in the one case is true in the other, the laws of mechanics as derived from the phenomena of sensible masses in motion being precisely the same as those of the insensible masses called molecules in motion; the magnitude of the mass does not affect the laws. Inferences can be drawn and results calculated *a priori* when the case is simply one of *vis viva*, but when the effects are referred to heat or to elasticity, nothing definite is apprehended. The erroneous notions of the nature of heat which so long prevailed were due to a failure in perceiving these facts. Nevertheless, the terms "heat," "elasticity" and "pressure," are so thoroughly interwoven in the units of measure, in the formulæ, in the literature, and in the reasonings of engineering science, that they will, probably, never be eradicated. They are brief and useful, and when their true import is known there are no objections to their retention.

One of the most important facts discovered by the experiments of Regnault is the increase in the latent heat of steam as its pressure becomes lower. If steam be expanded or lessened in pressure without doing external work, the difference of its temperature before and after expansion would tend to superheat it at the lower pressure, but as the latent heat increases with the decreased pressure, the tendency of this increase is to absorb heat, so that the condition of the steam after the free expansion—whether superheated or saturated—would be determined by the relative quantities of heat thus set free or absorbed. Now, the absorption of heat by the increase of the latent heat is greater than the heat liberated by the difference of temperature, so that steam expanding without doing external work would remain in the saturated state, a contrary result to the free expansion of an ideal gas, and, moreover, would undergo a liquefaction of a portion to furnish the heat required to maintain the remainder in the state of steam. Saturated steam, therefore, will partially liquefy by expansion *per se*, and to an extent determined by the excess of the increase in its latent heat over the heat due to the difference of its temperatures before and after expansion. If, however, the expanding steam does external work, there will be transmuted into the work of expansion a portion of the heat of the steam, and the quantity of heat thus transmuted is much more than sufficient alone to keep the steam in the saturated state, consequently, the whole of the difference between the latent heats due to the pressures before and after expansion will have to be furnished by the liquefaction of a sufficient portion of the steam to liberate the heat required to maintain the rest of the steam in the state of steam. Expanding steam, therefore, when doing external work, undergoes a partial liquefaction additional to the liquefaction due to this work, and in proportion to the difference between its latent heats at its pressures before and after its expansion. This liquefaction may be called the liquefaction due to the expansion *per se*.

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*A lecture delivered before the Sibley College of the Cornell University, Ithaca, N. Y.

(*To be continued.*)

THE GREAT DISCOVERER!

WALTER BESANT, in a work entitled "*A Glorious Fortune*," happily describes "the great discoverer," who is of all countries and of all times. It is so entertaining and so useful that we reprint it here for the edification of all:

"Reginald Ambler is nothing less, if you please, than the discoverer of the great truth that the world, so far from being a round ball, thoughtfully flattened at the north and south, so as to prevent the ice from slipping down and spoiling the equator, is really, as can be demonstrated with ease, a great flat circular disc of unknown thickness. What we call the Arctic Pole, believing that the world twirls perpetually and ignominiously round it, like a fat goose upon the spit, is in fact a central circle of ice and snow, the origin and cause of which must be left for the discovery of future philosophers; round it is the temperate zone; beyond this the torrid zone; beyond this again another great temperate circle, in which Australia, the Cape of Good Hope and New Zealand are comfortably placed; "neither het nor cauld," as the Scot said. Outside this vast temperate zone the ocean lies, a tract of sea indeed, immeasurable, desolate, without land or sail. Spread around in another, and the last, great circle, beyond the ocean at the outer edge, is a rim, ledge, hedge, barrier, frontier mark, boundary wall, or whatever the inadequacy of language permits us to call it, of thick, solid, mountainous ice. How broad is this rim, whether it stretches out forever into boundless space, whether it is narrow, so that perhaps some day the voyager may hope to reach its limit, and to peep over into infinity, no one can at present say. From time to time ships, which have sailed south, have reported cliffs, rocks and mountains, ice-bound, covered with snow, inaccessible, inhospitable, without life. Nothing lives in this boundary rim except, upon the edge of it, a few seals, walruses, narwhals, sword-fish, polar bears, whales and such sea monsters, who do not know how miserable they are. As for men, there are none at all, and will be none till time shall be no more.

"What is beyond the rim?" said Reginald, modestly; "I cannot say any more than the globe-professors can tell you what is beyond the furthest star."

This improved kind of earth requires an entirely new disposition of the heavens.

Reginald, quite early in the history of his discovery, remembered this, and constructed, with infinite pains, a beautiful orrery. In this the sun, no longer an immense globe of fire ninety millions of miles away, or thereabouts, but a comfortable little fireplace, so to speak, half-a-dozen miles above the world, went round and round above the great circle of the torrid zone, wobbling to north or south, so as to produce summer and winter. He pulled a string, and you saw the daily and the annual motion most clearly set forth. The moon and planets in the same way went on what seemed to be recklessly independent and dangerous paths of their own, and the fixed stars went round the polar star continually. By an ingenious adjustment of bars, eccentrics and curves, he accounted for all the natural phenomena—except one. This exception came home to him sometimes in the dead of night and took the conceit out of him. He had never been able to account for lunar eclipses. Why not lunar eclipses? It is too much to say that his faith ever wavered, but he was worried and rendered unhappy when he remembered that his orrery would account for everything except a lunar eclipse. But those moments, happily, were rare. Mostly he was content to gaze upon his model with a perfect satisfaction, to show inquirers over and over again how, upon a flat and stationary earth, all the natural phenomena, morning, noon and evening, with the four seasons, the phases of the moon, the winter's downward slope and the summer's elevation of the sun, can all be explained and accounted for.

Naturally, he became one of the bugbears—there are always half-a-dozen living at the same time—of the scientific world. He wrote to all the papers, journals, transactions, and reports of the learned bodies; he offered to lecture, he asked for an hour—only one short hour; he sent his name, with the offers of a paper, to the British Association, to the Social Science Congress, to the Balloon Society, to the Church Congress, to the Oriental Congress, to the Congress of Librarians, to the Congress of Headmasters, to the Geographical Society, the Geologists, the Society of Arts, the Physical Society, the Royal Astronomical Society, the Young Men's Christian Institute, the Sunday School Union, the Church Missionary Society, the Open-Air Mission, the Salvation Army, the Eleusis Club, the Grand Lodge of Freemasons and the Congress of Cathedral Vergers, not once, but every year, offering to read a paper, show his maps and models, and reconstruct the geography and shape of the world. It is sad to relate that no one paid the least attention to these proposals, and, being now fifty years of age, and with many years' experience, he had ceased to expect a hearing from these learned bodies, any more than he expected admission into the *Times*, *Standard*, *Daily News*, *Morning Post*, *Daily Telegraph* and *Daily Chronicle*, of the letters which he regularly sent them all once every year, after six months of preparation. As for the monthly, weekly and quarterly journals, he tried them all. They would have none of him. And as for eminent men of science, there was not a single mathematician at Cambridge, or a professor of science in any university or college of the United Kingdom to whom he did not propose a meeting, public or private, to discuss his theories. The signal victory already alluded to, which he achieved over the Rev. Mr. Bagshott, Baptist minister of Hackney Wick, in a public discussion held at the chapel, was an abiding proof of his strength in advocacy and the goodness of his cause.

The school is small—it consists really of two, the Prophet himself and Bagshott—but it is full of zeal. They have an office and an office-boy, in Chiswell Street. The office is a second pair back; the office-boy, whose hours are from nine to six, spends his time chiefly in the street surveying mankind; the publications—tracts and maps—of the society are on sale there, but no one has ever bought a copy except a journalist, who once saw his way to a scoffing article on the subject, and so bought everything there was, and put the things in his pocket-book and went away, and presently forgot all about it. In fact, there exists a general conspiracy against the Truth."

"Astronomers," said Mr. Ambler, "tremble at mention of my name for fear, but pretend to smile in scorn. They hope their system will last at least their own time, forgetting that to be found out after death will be more fatal to their reputation than to yield in life. In my autobiography will be found not only the 'Short Reasons,' but also the 'Argument at Length' and the 'Questions,' which I have sent to every one of them demanding a reply, a platform, a public discussion, or an opportunity to state my views. Not one of them has given me either. It will, indeed," he added, with a lofty sneer, "be greatly to the credit of the universities in the next century that they refused even to let me speak."

ELECTRICAL PRANKS.

IT has been known for some time in electric circles that alternating currents are able to cause considerable trouble in a way and to an extent at first quite unanticipated. Very naturally considerable reticence has been manifested by those interested. Certain facts have been brought to our knowledge, concerning which we did not feel at liberty to speak, since the communications made to us were, in a sense, confidential. The truth is, however, coming out, and as Mr. Preece has not hesitated to speak pretty strongly on the point, we no longer feel the necessity for keeping silence. Most readers of this journal are no doubt familiar to some extent with the phenomena of induction. For the benefit of the minority, however, it may be advisable to say in a few words what the term implies. When a current of electricity is made to pass through a wire, another current, moving in the opposite direction, is set up in any other wire near it. The action is instantaneous. If the initial current is steady, the secondary current vanishes, to be re-established for a minute fraction of a second when the initial current is broken. One type of a dynamo gives continuous currents; another gives alternating currents. The first, for the reason we have stated, will not set up currents after the first instant of time in a wire in proximity to the main lead; but the alternating currents, because it is made, broken, and reversed hundreds of times in a second, will continue to set up opposite currents in another wire. A well-known example of this action is supplied by the Rhumkorff coil. It is a peculiarity of this inductive effect that the intensity of the current set up in the second wire depends largely on its diameter and its length, as compared to those of the primary wire. The high tension system of electric lighting depends for its success on this principle. Currents small in quantity, alternating and of very high tension, are sent through small cables to "transformers." These consist, roughly speaking, of coils of fine wire surrounding other coils of coarse wire. The initial currents in the fine wire set up secondary currents, larger in quantity but much lower in tension, in the coarse wires, and these low-tension currents are then transmitted into houses and used for lighting. The pressure is so small that they are perfectly safe. The object had in view is to employ small cables for the transmission of the current through long distances and so avoid an enormous outlay on conductors. The dimensions of a cable are fixed by the quantity, not by the pressure; and by augmenting the latter much smaller quantities of copper are required for conducting a given amount of energy to a given place than would otherwise be needed. Currents with a potential of as much as 10,000 volts are let down by the transformers to 150 or 200 volts. The system has rendered it possible to put up electrical works at long distances from the places to be lighted in situations where ground space is readily available, and coal can be had at a more moderate price than would be possible if cartage were necessary.

So much premised, our readers will be in a position to understand the nature of the pranks which these high tension alternating currents are playing. There is no limit, it must be understood, to the distance at which the inductive action takes place. It is one of the special characteristics of electricity that it sets time and place at defiance. It is impossible, indeed, to cause a disturbance in electrical equilibrium anywhere that will not be felt everywhere. The magnitude of the influence becomes, it is true, reduced by distance, but the influence remains, and with such delicate instruments as the telegraph and the telephone, working as they do with excessively minute currents, great disturbances may be caused by apparently insignificant causes. The currents sent from the great Ferranti dynamos, at Deptford have a potential of about 6,000 volts at present, which may be, and most likely will be, augmented before long to 10,000 volts. A temporary cable or main lead of the Fowler-Warning type was laid in the first instance alongside the Southeastern Railway from Deptford up to near London Bridge, pending the completion of Mr. Ferranti's tubular conductors. The first effect of sending a current through the cable was to render all the telegraph instruments in the signal-boxes untrustworthy. The instruments played all sorts of pranks. This difficulty was got over, and then it was found that the evil influence extended to Paris. In Mr. Preece's words, as reported in the August number of the *Journal* of the Institution of Electrical Engineers,—"There is at the present moment a very troublesome source of 'foreign currents' in our wires, due to the induction of the high-pressure alternate-current system generating the electric light. A company who have established a central station at Deptford, and who mean to distribute currents over London at very high pressure, have given the Post-office very abundant evidence of their presence. Most of our wires to the South of England have, more or less, during the last six months been disturbed. At one time the disturbance was very marked indeed, even observable in Paris." When the current was taken over to the Grosvenor Gallery installation, a telephone central station nearly half-a-mile off was for a time rendered useless. From America we learn that, strange as it may appear, the use of electrical currents for propelling tramcars, etc., has even interfered with the transmission of messages through the Atlantic cables.

In Boston, U. S. A., the effect of the electrical street railways on the telephones has become so serious that it has given rise to endless litigation between the telephone companies and the street railways companies. The distances over which induction makes itself practically felt are surprising. Mr. Preece says: "At one of the meetings of the British Association I pointed out that, by experiments carried out by Mr. Arthur Heaviside in the neighborhood of Newcastle, we were able to detect the presence of these currents of induction at distances not to be measured by feet, but often by miles. We had some indication of very powerful currents sent between Newcastle and a station a little to the north. Another circuit on the other side of England was between Gretna and Shapfell. We had distinct traces at Gretna—forty-five miles away—of currents originating in Newcastle, and these were due to induction." At Blackpool, again, the stoppage and starting of the electrical tramcars running with continuous currents sets up induction currents, which cause trouble in the post-offices and telephone stations. Nor is it induction alone that interferes with the transmission of messages. In many cases, to save the expense of return wires, the earth is used for the purpose of carrying back the current to the dynamo. The electricity in such cases diffuses itself pretty freely, hunting out the lines of least resistance, and thus a telegraph circuit may be seriously affected by a wire which goes to earth.

The higher the potential the more powerful is the influence exerted all around. Concerning these mighty alternating currents very little is yet known, but day by day facts are coming out which are sufficiently startling, and of which many examples might be supplied. Thus, for example, it has been found that the ordinary forms of switch are useless. The current will "spark" across a gap of fifteen or sixteen inches, burning up the brass or copper. The interposition of a non-conducting plate does no good, as the current will run round it as water would. The most effectual way of dealing with it seems to be to blow the arc out by a strong current of air. An arc lamp can be blown out as easily as a candle. Again, there is reason to believe that the potential rises instead of falls in a long cable, as we get further and further from the source of supply, the ampères or quantity being converted in some mysterious way into volts or intensity by what has been termed a "packing" of the current at the end of the conductor. There is excellent reason to believe that some of the deaths and fires which have been caused in the United States by electricity have been caused by induction, and some by the "earthing" of wires at moderate distances from the line on which the death or the fire took place. In all these electrical pranks there is no cause for alarm as to the future success of electricity as a lighting agent, or as a motive power for tramcars and machinery; but it would be folly to assert that the inventive powers of electricians will not be taxed in dealing with such difficulties as we have named. All trouble from "earth" currents can be got rid of by using proper return leads, and it is by no means beyond the powers of the electrician to keep the range of inductive action within reasonable bounds. The most startling feature about the whole matter is the annihilation of space to which we have called attention. It seems strange that an electric light installation at Deptford should affect telegraph needles in Paris; but it is really not half so remarkable in one sense as the circumstance that pressing down a button here should deflect a soft iron needle in Vienna or St. Petersburg practically at the same instant. Even the absurdly wild vagaries of electricity are known to follow rigid laws, the nature and value of which are beginning to be so well understood that the very characteristics of alternating currents now regarded as objectionable may be utilized. It has been proved, for example, that it is possible to telegraph over some distance without using a wire as a connecting link between the sending and receiving instruments.—*London Engineer.*

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Friends will observe by our club rate list, that we make a reduction of 50 cents on each name where ten subscribe at one time, and give one copy free one year to the person sending the club. It is a good time to begin now to get ten names.

◆

Charles Dudley Warner is quoted as saying that the difference between the "faith cure" and the "mind cure" is that the "mind cure doesn't require any faith, and the faith cure doesn't require any mind."

FLYING MACHINES.

In the matter of flying machines, an investigator, M. Drzwicki, shows that in flying birds, the smaller the sustaining surface in proportion to their weight the greater is their customary speed. He gives a table of the proportions of some 61 birds, which shows that the surfaces of the body and extended wings range from 7.56 sq. ft. to the pound for the bat, which flies at the rate of about 20 miles per hour, to 0.43 sq. ft. per pound for the male duck, who progresses at about 60 miles per hour. He estimates that for a speed of 90 miles per hour, the surface required will be but 0.22 sq. ft. to sustain a pound of weight.

M. Drzwicki estimates that an apparatus of the best possible proportions as to exposed surface and form, and sailing at an angle of 1° 50′ 45″, will require to drive it at 25 miles per hour but 5.87 h.p. per ton of its weight. This assumes the thickness of apparatus and consequent hull resistance to be but $\frac{1}{100}$ of its horizontal dimensions, while for birds it generally runs from 5 to 10 per cent. That is to say, that birds exposing a horizontal surface of say 100 sq. in., generally expose a maximum cross-section vertically of 5 to 10 sq. in., while M. Drzwicki believes this can be reduced to the proportion of 1 sq. in. per hundred for an aeroplane.

O. Chanutes' estimate of the power required by a common pigeon gliding at an angle of 1° with the horizon was 9.33 h.p. per ton of his weight, and 10.49 h.p per ton at an angle of 2° for this same velocity of 25 miles per hour.

These are considerably less than the powers required to drive a balloon of moderate size at the same speed, for the airship '*La France*' would require 51 h.p. to attain 25 miles per hour; or, as it weighs 2.2 tons, the motor would needs develop 23.2 h.p. per ton of the weight of the whole apparatus. For the balloon of double this size, the power required is at the rate of 10.34 h. p. per ton of apparatus. This power required would moreover increase in the case of the balloon, as the cube of the velocity, while M. Drzwicki shows that in the case of an aeroplane the power will increase only in the direct ratio of the speed, because as the velocity becomes greater the area of sustaining surfaces required becomes less, and he estimates that an aeroplane will require 10.43 h.p. per ton to go 44.72 miles per hour, and 20.62 h.p. per ton of its weight at 89.44 miles per hour.

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Prof. A. Kennedy recently made some experiments on an English plant with some extraordinary results. The critics are sharp after him, to wit:

Turning next to the temperatures of the gases, we get some very remarkable figures. The total boiler pressure was very nearly 112 lbs. per square inch; the corresponding temperature is 336 deg. But Professor Kennedy tells us that the temperature of the gases leaving the boiler was only 328.6 deg., or actually some 7 deg. or 8 deg. less than the heat of the water in the boiler. The gases were positively cooling the boiler down. Such a thing never before was heard of in a carefully conducted experiment. I am bound to believe in this because Professor Kennedy says it is true; but if I had obtained a similar result myself, I would not believe it. It is too much to ask Professor Kennedy how the gases were cooled below the boiler temperature, and if he ever met with a similar case?

◆

A **steam** life boat has been constructed in England which is propelled by a jet of water, and is said to work well where she has been tried—if it is possible to try a lifeboat out of regular service. The sea is no respecter of boats, and it sometimes up-ends them in the surf, to say nothing of end-over-ending them; just how the boiler would act under such conditions and how the funnel would like it can only be told by trial.

TRADE NOTES.

Charles J. Hathaway is now with Messrs. Hine & Robertson, 48 Courtlandt Street, engaged in pushing their specialties in engineers supplies.

* * *

Riley & Cowley, South Brooklyn, N. Y., recently built a small triple-cylinder expansion engine for a steam launch, the cylinders being $\frac{4''\times6\frac{1}{2}''\times10''}{8''}$

* * *

William Murphy, a well-known marine engineer of this city, and a member of No. 69, M. E. B. A., has taken a month's vacation in which to visit friends in the old country.

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It should be understood by owners and builders of steam vessels that the sole right to build independent condensers, embodying the duplex principle, is secured to Henry R. Worthington by letters patent of the United States and Great Britain.

* * *

Lake navigation is very materially interrupted by ice during the winter months, but during 234 days of last year tonnage was passed through the Detroit River to the amount of 10,000,000 tons, which is more than the entries and clearances of all the seaports of the United States, and 3,000,000 tons more than the combined foreign and coastwise shipping of Liverpool and London.

* * *

Mr. E. J. Waring, the former representative and treasurer of the Hall Steam Pump Co. in this city, will be no longer with them, but after Nov. 1, 1890, will be General Manager and Treasurer of the Rosendale Belting Co., at 26 Broadway, New York, or at Euclid Avenue, Newark, N. J., where he will be pleased to meet or correspond with all interested in belting of a superior kind.

* * *

After September 30, the present New York office of the Hall Steam Pump Co. will be discontinued, and it is desired that all who have been dealing at that office will continue to favor the Company with their trade, and address all mail matter to Pittsburg, Pa., where the Works are located. Every effort will be made there to give expeditious and satisfactory attention to all orders and inquiries.

* * *

The Wilmington Steamship Company's new steamer '*Neuse*' was launched at the Harlan & Hollingsworth Company's Works on Monday. The '*Neuse*' is 200 feet long, by 31 feet beam, by 11 feet depth of hold. The motive power consists of twin screw triple-expansion engines, 12 in., 20 in., and 30 in. diameters of cylinders, by 20 in. stroke of piston, supplied with steam by two boilers at 160 pounds pressure.

* * *

In the New York Post-office stamping is now done by a machine which will cancel, postmark, count, and stack letters and postal cards at the rate of about 25,000 per hour. In two hours and two minutes it canceled, postmarked, counted, and stacked 46,480 letters and postal cards, of which 21,000 were letters. The machine is driven by an electric motor, but can be run with foot-power like a small printing press.

* * *

The firm of William Cramp & Sons will in future be known as William Cramp, Sons & Co. Several prominent New Yorkers have obtained control of a considerable portion of the stock. This is the first time, so far as is known, that there has been any stock of the establishment held outside the Cramp family. According to the agreement drawn up, the members of the Cramp family will fill all the offices of the company during the next five years.

* * *

The track which will be laid in the tunnel under the St. Clair River, will consist of rails weighing 100 pounds to the yard to bear the weight of heavy engines. The Grand Trunk Railway of Canada has ordered from the Baldwin Locomotive Works four large locomotives for use in this tunnel, which will weigh when completed 90 tons each. The steep grades in the tunnel which is two and a half miles in length, as well as the heavy loads which will be transported, will render useless any ordinary engine.

* * *

Among the orders now being filled at the Baldwin Works are 28 locomotives for the Chicago, Burlington and Quincy, 33 for the Union Pacific, 30 for the Gould system, 48 for the Denver and Rio Grande, 28 for the Northern Pacific, 20 for the Baltimore and Ohio, and 12 for the Chicago Rock Island and Pacific, besides a special order from the Manhattan Elevated Railroad of New York for 30 engines to be constructed under the English system with wrought iron driving wheels.—*Philadelphia Press*, Sept. 11.

* * *

The principal submerged torpedos are the '*Patrick*,' the '*Sims-Edison*,' and the '*Brennan*.' The first two claim a speed of 20 miles, the latter 27. The '*Patrick*' weighs about 5,000 pounds, carries a charge of 300 pounds, and costs $15,000. The '*Sims-Edison*' weighs about 4,500 pounds, carries a charge of 300 pounds, and costs $7,500. They are connected with and operated from the shore by means of cables, and must be seen by the operator in order to be directed at their maximum range, which is from one two miles for each. Only a single one can be manipulated from each dynamo.

* * *

Many British war ships are provided with electrically illuminated night sights. The front sight consists of a metal socket with a small cone of pale green glass, point up, only the rear half showing. Beneath is a small incandescent lamp whose light shines up through the base of the cone, and is reflected to the rear. The rear sight has, instead of the cone, a V notch, and a light is reflected from a ruby-colored glass. In sighting, the two colors are brought into coincidence at the bottom of the notch. The current comes from a small battery established for each gun in a water-tight box.

* * *

The '*El Sol*,' a new ship for the Morgan Line Ss. Co., is said to be the most complete American steamer afloat. Her length is 404 feet 6 inches, breadth 48 feet, and depth of hold 33 feet. Her displacement is 6,750 tons. The engines of '*El Sol*' and those of her sister ships were designed by Horace See, of this city, to whose skill much of the Cramps' best work is due. The engines are of the vertical, triple-expansion type, of 3,500 h.p. The valve gear is on the most improved pattern. There are three double-ended boilers, each with six furnaces, supplying a working pressure of 160 pounds to the square inch. The propeller is 18 feet in diameter.

* * *

The Rogers Typograph is the name of a new typesetting, or, more properly speaking, typemaking machine, which has been adopted by several New York papers. The machine is operated with a keyboard, similar to that of a typewriter, the action of which is to assemble in line a series of matrices, into the faces of which a bar of molten type metal is cast. It is very simple of construction, and gives very satisfactory results. It is expected that by next November machines will be simultaneously delivered to all newspapers in New York which have contracted for their use. They are being manufactured by the Rogers Typograph Company, Cleveland, Ohio.

* * *

Although there are some slight repairs to be made on the '*Dolphin*,' there can be no doubt that she is one of the sturdiest vessels in the navy to-day. She began with a speed of 15.11 knots on her contract trials, and she can do as well now. In the meantime she has traveled 61,000 miles in something over twenty-two months, and has been under steam 10,000 hours. In her cruise around the world she stopped for repairs only once, and then for only two hours. This performance is said to be without a parallel in the history of naval achievements.—*N. Y. Times*.

[Yes, but it is no of use to say this now; John Roach can't hear it.]

* * *

When about to examine, clean, or paint boilers, the following cautionary measures must be adopted: They should be opened up and well ventilated, a connection being made to a fan system if possible. This done, the purity of the air should be tested before entering by burning a candle on the bottom at least five minutes. Working parties inside must always maintain communication with some one outside; they must always have with them a lighted candle and withdraw should it begin to burn dimly. No naked light is to be taken into a coal bunker until it is ascertained that no explosive gas is contained therein. Special precautions in this respect should be taken for some days after coaling. The ventilation of coal bunkers should receive careful and constant attention.

* * *

Now that the British naval manœuvres are over, various authorities are engaged in pulling the fleet to pieces. One writer has set himself the task of proving that certain well-known ships are unable to steer straight, others burn more coal than the Admiralty, believe and cannot steam at the rate which the Admiralty provide. The '*Ajax*' is taken as an example. With 850 tons of coal she is supposed to be able to keep the seas at a speed of 10 knots, and to steam 4,000 knots. But with an addition of 350 tons of coal and a rate of 7 to 8 knots, she could only steam 3,600 miles. When she reached Torbay there were only twenty-three tons of coal in her bunkers. The belted cruisers are cited as equally disappointing. The '*Forth*' and '*Severn*' cannot do more than 4,800 out of a promised 7,400.

* * *

A problem at present engaging the attention of naval architects is the construction of an entirely new type of war ship adapted for coast and harbor defense. This craft should be of moderate dimensions, not exceeding 150 feet in length, of great speed and handiness, and presenting to the eye nothing but a continuous turtle-back deck extending only slightly above the water, and constructed of plates sufficiently thick to withstand a glancing shot, even from a heavy gun. This kind of vessel would be used exclusively for ramming purposes, and should have the propeller or propellers so placed as to allow of using the bow or stern for ramming with equal efficiency. Such a vessel being almost invisible would rarely be hit by the enemy's shots, and would, especially at close quarters when no heavy guns could be brought to bear, be almost invulnerable; its handiness would make it a most formidable opponent.

* * *

The '*Patrick*' is a controllable fish torpedo, propelled by twin engines—driven by carbonic acid gas carried under high pressure. The charge is 400 pounds of dynamite, or other high explosives, carried in the forward compartment. The engines are controlled and the craft steered from shore by electricity, carried by a cable. The torpedo is maintained at the proper depth below water by a float, which is provided with two flags to steer by in the daytime, or two lights, visible only from the rear, for use at night. The contract called for a speed of twenty knots an hour for one mile and for good manœuvering qualities. A speed of twenty and one-half knots was attained and the torpedo responded readily to the electric controlling devices. Its extreme range was shown to be about two miles. As the usefulness of controllable torpedoes on board ship is very doubtful, the navy will not contract for any more of this type, but it is expected the good results obtained will result in the '*Patrick*' torpedo being taken up by the army for harbor defense purposes.

* * *

The maximum horse-power of the '*San Francisco*' was 10,604.32, and, as this was made during the latter part of the run, it indicates that, with proper handling of the engines and better work in the fire-rooms, the average would have been above 10,000. No accurate data of the coal consumption on the trial was taken, but the ratio of horse-power to the grate surface in the furnaces indicates that she is a very economical ship in the use of fuel. She developed 17.46 h. p. per foot of grate surface, against 14.89 for the '*Baltimore*,' and 13.44 for the '*Philadelphia*.'

As the vessels are not all of the same size, the fairest comparison is the ratio of power to weight, and in this respect the '*San Francisco*' makes much the best showing. She made 10.84 h. p. per ton, against 10.53 for the '*Baltimore*,' and 10.35 for the '*Philadelphia*.' This is the best result that has yet been obtained in large marine engines in this country, and probably the best attained anywhere, without making the machinery dangerously light, as has been done in many instances in the British Navy, and the work is highly creditable to Engineer-in-Chief Melville, who designed the engines, and the Union Iron Works, where they were built.

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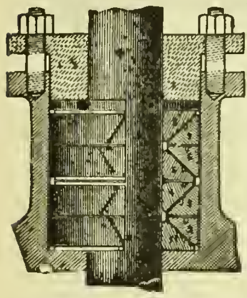

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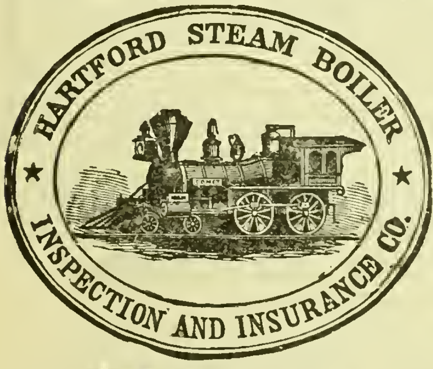

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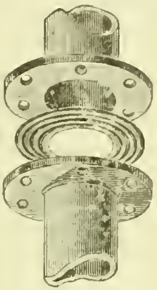

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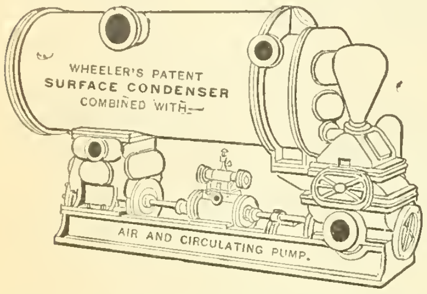
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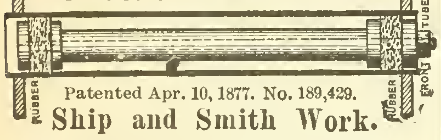

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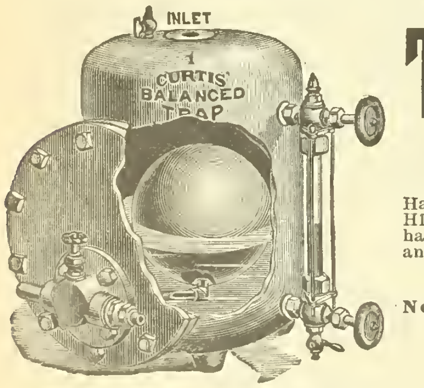

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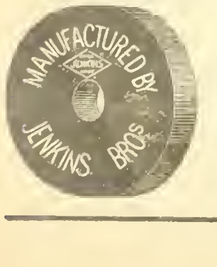

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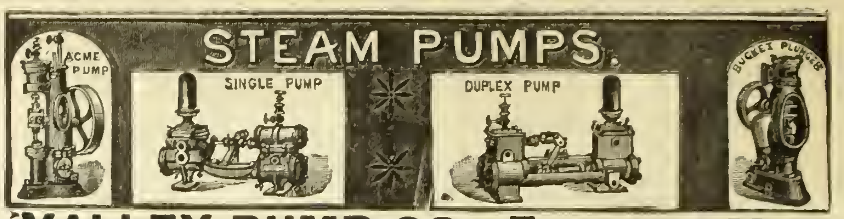

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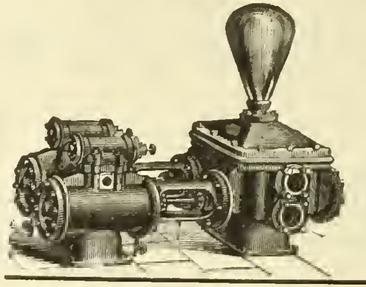

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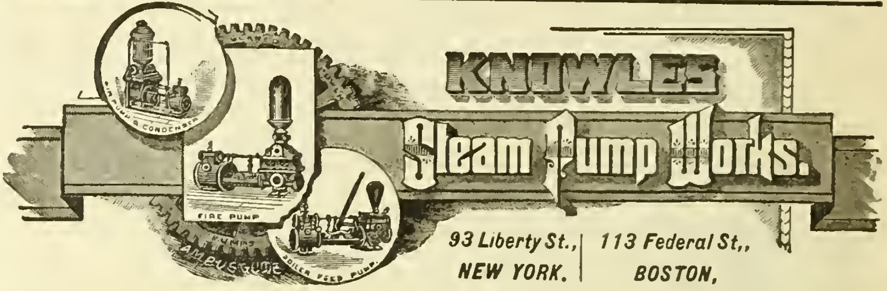

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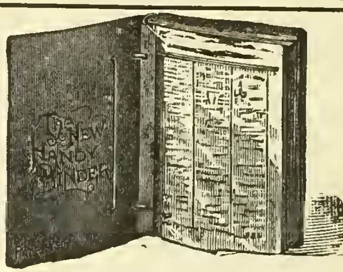

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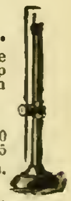

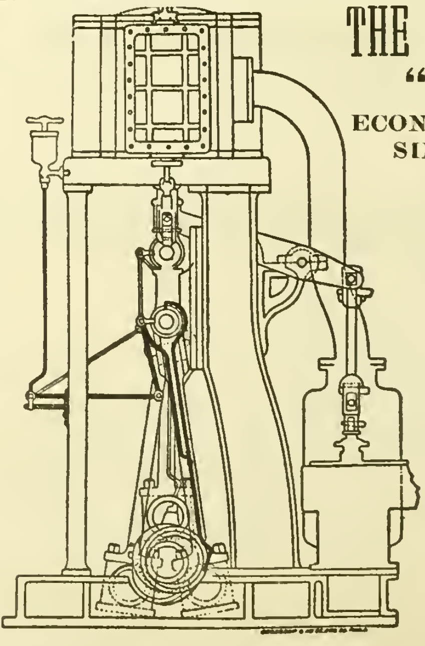

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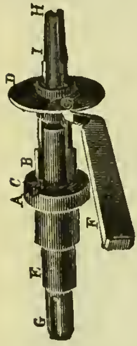

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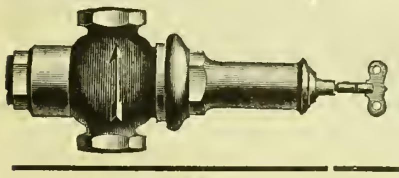

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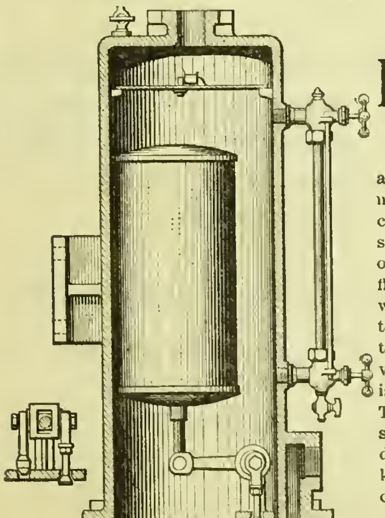

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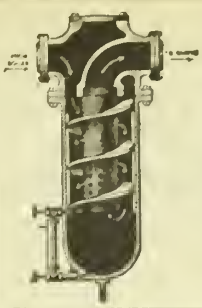

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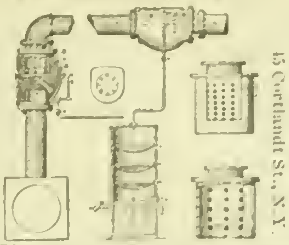

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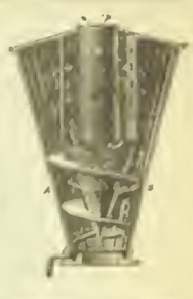

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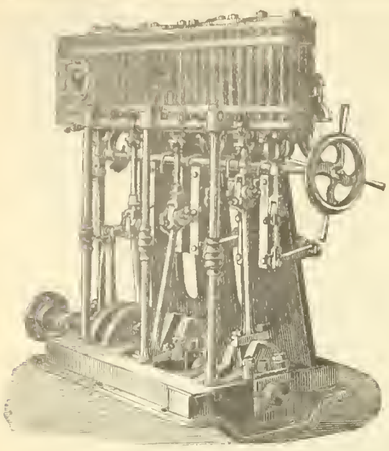

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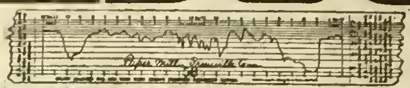

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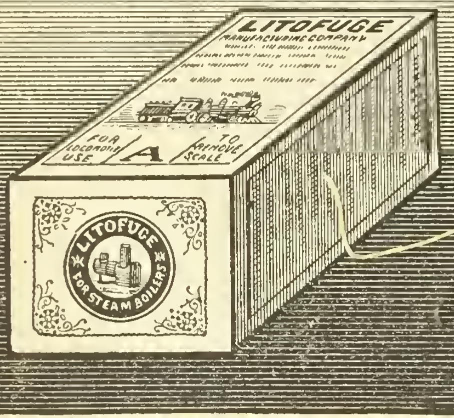

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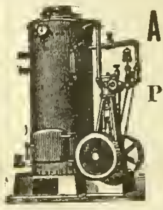

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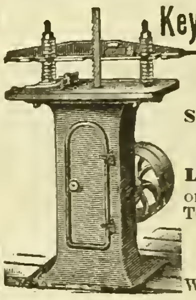

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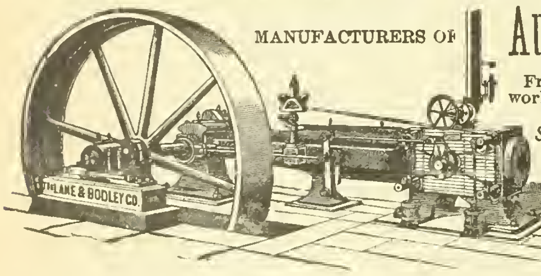
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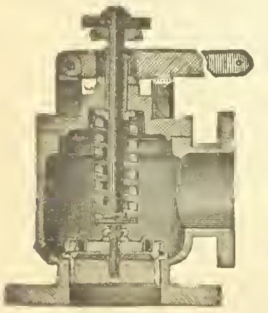

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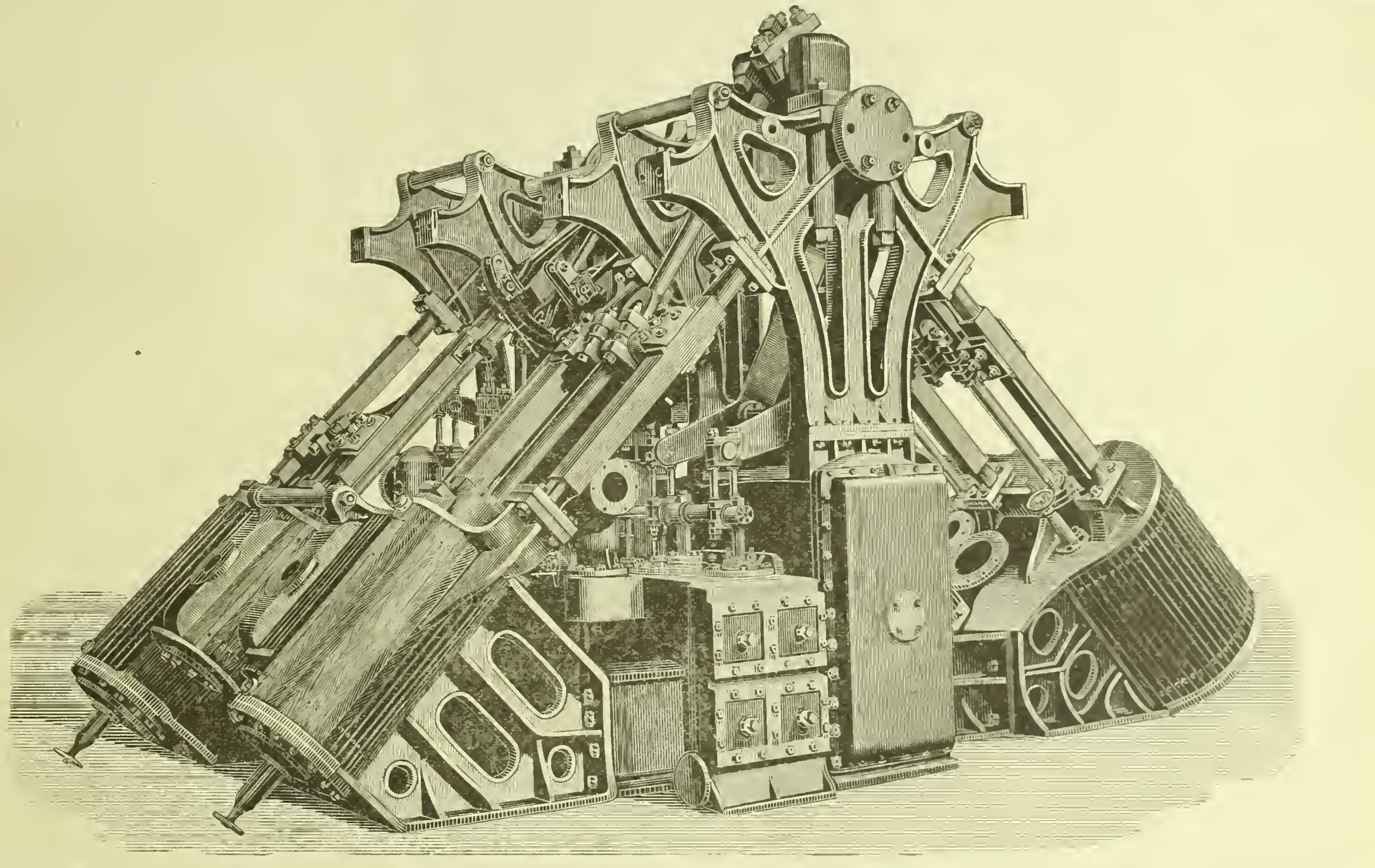

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In making fine castings of pure aluminum the metal should be poured immediately after it is melted; if it is allowed to attain a red heat the casting is almost certain to be full of fine blow-holes. In pure aluminum castings, requiring machine tool work upon them, it is customary to add from three per cent. to seven per cent. of copper to the metal; this slightly reduces the toughness of the metal and prevents clogging of the tool, which would otherwise ensue. A small percentage of silver added to the metal is advantageous when a little increased hardness is desirable, especially in the fine art castings.

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The present output of aluminum by the Pittsburg Reduction Company is 375 pounds per day, an amount insufficient to supply the demand upon them, and plans are in preparation for the erection of a plant having a daily capacity of five tons, or over three million pounds per year.—*American Manufacturer.*

THE PARROT GEAR.

If you want to see a perfect universal motion, consider the parrot and be wise. A parrot can twist itself in more ways and directions at one and the same time, and never let go its original foothold, than any other artificial or natural object known to us. Edward Marsland brought us a large green parrot from Brazil last winter, and we have not got tired of studying it yet. The parrot puts his go-ahead motor in gear, and pretends that he is going on a long run across the top of his cage; he gets about six inches out of his depot, and then remembers that he has forgotten something and turns right back through himself, apparently; his drivers are going ahead all the while, but his body comes back between the top of the cage and his feet, and there he is, reversed, with the lever over in the corner all the time. He can go four ways at once: up in the air, down below, forward, or back, all without shifting his links. As for other miscellaneous motions that don't count for much—in the parrot's mind—he is full of them. A parrot can move his legs upward and outward at right angles to the center line of his frame, and arrange his hair with calmness and decision. Take him, apparently asleep and unawares, and touch him behind, and as soon as your hand reaches his body his claw reaches your hand, and the grip of it is amazing in its strength. A strong man cannot grip with one finger as hard as a parrot can with its two toes or claws; he has a grip like a Spanish windlass. And the clinch of his claw is not the most wonderful part of it; it is a hand more than it is a foot. A parrot can swing by its feet on a string not an eighth of an inch in diameter, and it can roost as well on a curtain-rod three-sixteenths of an inch in diameter, as upon its perch one inch in diameter. Whatever a parrot gets hold of it never releases until it gets ready, and it can stand on one hand and eat out of its other hand a good deal longer than a man can. The parrot is a trapeze performer of the very first order, but he is out of place on the ground. He is a climber, not a walker, and makes a poor show on a flat surface; he seems to know that he is absurd in this position, and relinquishes it as soon as possible. He gets out of line too quick, and pounds, clop, clop, until he gets on a perch again. The parrot's gear is a wonderful adaptation of means to ends.

◆

The *Popular Science News* insists that the great error almost invariably made by persons unfamiliar with the subject is in considering electricity as a source of unlimited power in itself, when, in reality, it is only one of the many manifestations of energy and a convenient way of applying power previously produced. A current of electricity is like a current of water. It gives out power in falling from a higher to a lower potential, just as water turns a mill-wheel as it falls from a higher to a lower level, but neither have any power in themselves. The radiant energy of the sun has lifted the water from the ocean to the hills, and the same radiant energy has been stored up in the coal plants of previous ages, and is liberated and transformed into power in the furnaces and boilers of modern steam engines.

[Yes, we shall get the truth bye-and-bye, if we all keep insisting upon it.]

◆

To infringe a patent it is not necessary that the thing patented should be adopted in every particular. If the patent is adopted substantially by the defendants, they are guilty of infringement.—*Scientific American.*

◆

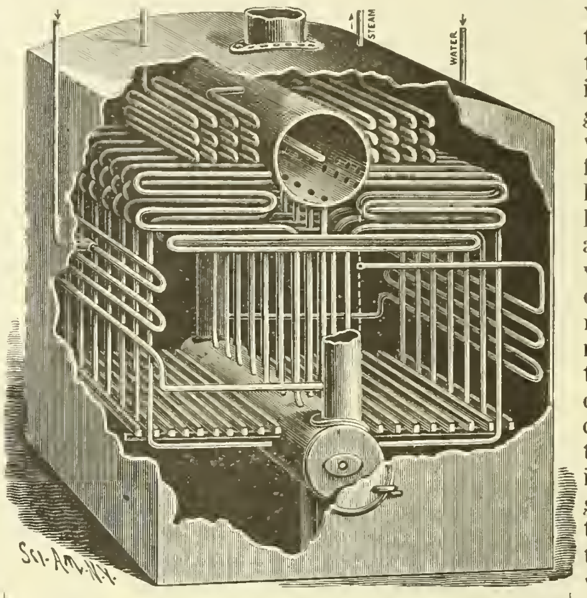
In a monthly report of engines on the Grand Trunk R R., the average consumption of coal was 121.6 pounds of coal per square foot of grate surface per hour.

◆

The man who has sand—moral sand—that man will come out all right.

CONEKIN'S WATER-TUBE BOILER.

The engraving herewith represents a water-tube boiler recently patented by Dawson Conekin, a practical marine engineer of this city, well known to the members of the trade. As will be seen, it is entirely safe from destructive explosion, and very high pressures can be carried upon it. The water circulation is wholly natural—not forced or pumped through from the top—and is very active. At the same time the feed is under perfect control at all times, and there is no danger of the tubes becoming overheated from stopping and starting the engine in handling the vessel in a crowded harbor. The steam drum is connected with the water drum by large tubes at each end, on the sides of which are the fire boxes, the grate bars being a little above the middle of the water drum; from this pipes run under the grate bars and upward on the outside of the fire box, to form coils connecting with the lower part of the steam drum. A second series of pipes leads from the water drum upward inside of the fire boxes, forming cross coils, connecting with the steam drum a little higher up, but below the water level in the steam drum. The bottom of the steam drum connects with the top of the water drum by a series of pipes, each having transverse bends at the top of the fire boxes and under the coils extending from the side pipes. The feed pipes on each side of the casing connect with a longitudinal series, the upper end of which connects with the downcast tube at one end, while the lower end of the series connects with the downcast tube at the other end of the boiler. On the sides of the steam drum are coils of pipe through which the steam passes when taken from the upper part of the drum, so that the steam is superheated before it reaches the engine. The heads of the water drum have manholes, and one head of the steam drum has a plug to use a hose to clean the steam drum and the pipes leading therefrom to the water drum. By means of this type of boiler a thorough circulation takes place from the steam drum downward through the downcast tubes to the water drum, the hot water passing upward through the several series of pipes as stated.



The inventor's address is Dawson Conekin, 646 Hicks Street, Brooklyn, N. Y.

◆

Is there any such thing as luck? Perhaps not; but the crew of the fishing schooner '*Crane*' will say there is, for they fell over an English torpedo boat, No. 62, abandoned on the high seas, on the 12th instant. The boat is worth $25,000, and the crew will get big salvage money.

◆

We think that there is $2 worth of information in this issue alone. Observe the wide range of the topics discussed, and the status of the writers of them! There is food for many an hours reflection in absorbing the results of the experience of others.

THE EXHAUST.

It is a curious circumstance that in this country very little importance has been attached to the detail of exhaust in any engines. It has always been deemed enough so to scheme matters that the back pressure shall be very small, and if this end is secured it is supposed that all has been done that need be done. The most fastidious care is taken to get a sharp cut-off and a square admission curve to a diagram; but the exhaust end is left to provide for itself pretty much. But it should be obvious that to open the exhaust too soon is simply to waste steam. Under proper conditions, the exhaust port would not open until the crank was on the dead point. A large opening to the condenser would then be made, and the valve would then be allowed to close quietly as the piston neared the opposite end of its stroke. In short, to get the best results, the exhaust valves should be worked with trip gear like the admission; but with this difference, that the valve should fly open instead of shut, the instant the detent was tripped. Using trip gear for admission is only doing one-half of what ought to be done. If trip gear is good for admission, it is equally excellent for exhaust. We have seen diagrams from Corliss engines which were as good as possible at the admission end, while at the tail end was a long sloping line representing waste of steam and pressure. The effect is very much the same as though the piston leaked near the end of its stroke. The steam intended to do work should be retained in the cylinder as long as possible, and only discharged at the last moment But in only too many cases the exhaust is so sluggish in its action, that unless the exhaust port begins to open at a comparatively early period, the port will not be open wide enough after the crank has turned the center, and there will be heavy back pressure. In not a few so-called Corliss engines, otherwise well designed, we have met with this defect—a defect, we may add, from which most French and Belgian engines are free.—*London Engineer.*

◆

GAS STOVES.

As a result of some experiments by an English chemist, it was found that gas stoves, which are supposed to burn gas very perfectly, are very wasteful, the amount of carbon which escapes unconsumed being considerable. The experimenter says:

The amount of flue gas passed in each experiment was about 1 cubic foot, and although the variations were considerable, the general results were conclusive in showing that the combustion of gas, when burned in gas stoves for heating purposes, is much more incomplete than one might be led to suppose

The only burner in which the weights of the test tubes remained constant after passing the burned gas, and in which the combustion was presumably complete, was in a kerosene oil lamp in which the flame was not turned to its highest point. In another experiment, with the flame turned full on, 12.04 and 3.09, respectively of carbon and hydrogen, escaped combustion per 1,000 of carbon completely burned.

The next nearest approach to complete combustion was in an Argand burner, in which all the carbon was completely burned, but an amount representing 0.2575 parts of hydrogen escaped combustion per 1,000 parts of carbon completely burned, whilst in a second experiment 0.113 of carbon and 2.5414 of hydrogen escaping combustion were registered per 1,000 parts of carbon completely burned.

◆

J. D. Benton, who made all the gold and silver models of steamers, locomotives, etc., seen at railway stations, died in Providence, R. I., recently, at the age of 66.

◆

The report that the famous viaduct at Kinzua, Pa., would be destroyed soon is erroneous.

BULKHEADS.

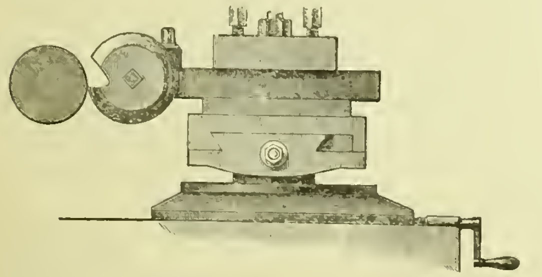
In regard to the value of bulkheads this question was fully debated in 1866 by the Council of the Institution of Naval Architects. That Council decided that no iron passenger ship is well constructed unless her compartments be so designed that she would float safely were any one of them to fill with water or be placed in free communication with the sea. They recommended that all iron ships should be so divided that not only the largest compartment, but any two adjacent compartments, might be given up to the same without sinking the ship. This latter is an advisory clause, the wisdom of which is not disputed. The first, however, is condemnatory of all badly-constructed ships.

During the twenty-four years which have elapsed since these important decisions were made, they have been absolutely ignored by everybody concerned, and all iron and steel sailing ships, and the great bulk of steamships, have been built without the slightest regard to the recommendations of the Council, and in so far as they are used for carrying passengers, all of these ships are, in the judgment of the Council, badly constructed. It is quite true that there are water-tight bulkheads, one or more in every such ship, but they exist for structural purposes only, and not to prevent the foundering of the ship when run into. Sailing ships generally have but one bulkhead forward. Some, a very few, have added another "collision" bulkhead aft. Others have introduced one or two in addition to these two "collision" bulkheads, but these are merely dead weight, adding, of course, to the strength of the ship, but not appreciably altering the time of foundering if she were struck anywhere between the bulkheads. The highest number of bulkheads believed to be built in any existing sailing ship proper—that is, an "unconverted" vessel—is four, and these are not placed so as to materially alter the time in which a vessel would founder if struck in any compartment.—*Unknown.*

◆

NEW TURNING TOOL FOR LATHES, ETC.

What is called a new turning tool for lathes, and machine tools in general, has just been brought out in England, and is shown in the engraving herewith. There is nothing new in it, the same principle being adopted in the cutters of moulding machines for sticking wood mouldings for joiner work. Why this tool is entitled to a patent is one of the mysteries of the patent laws.

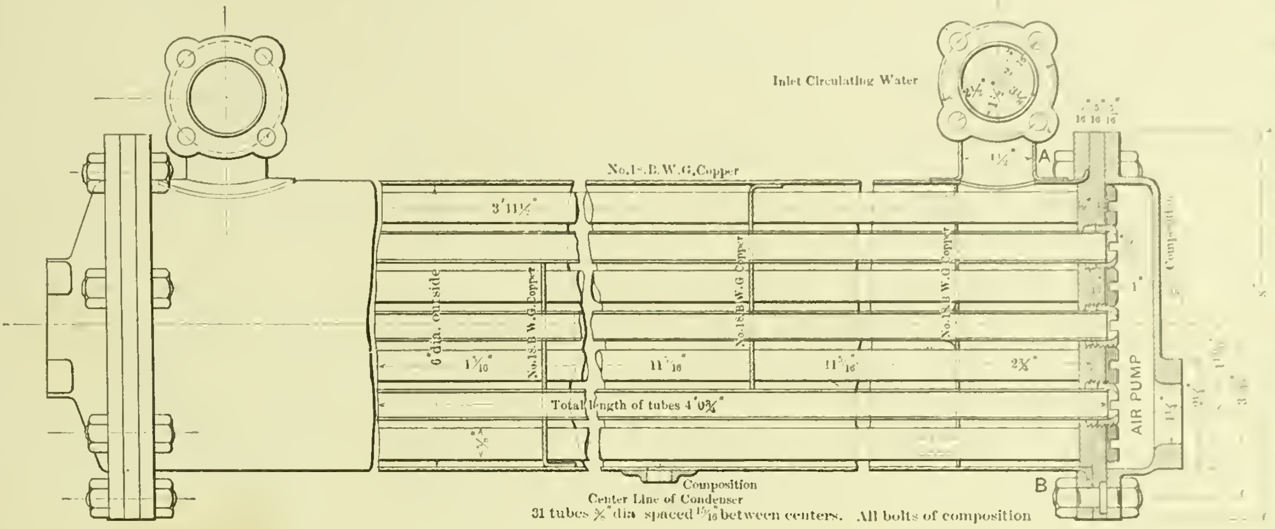


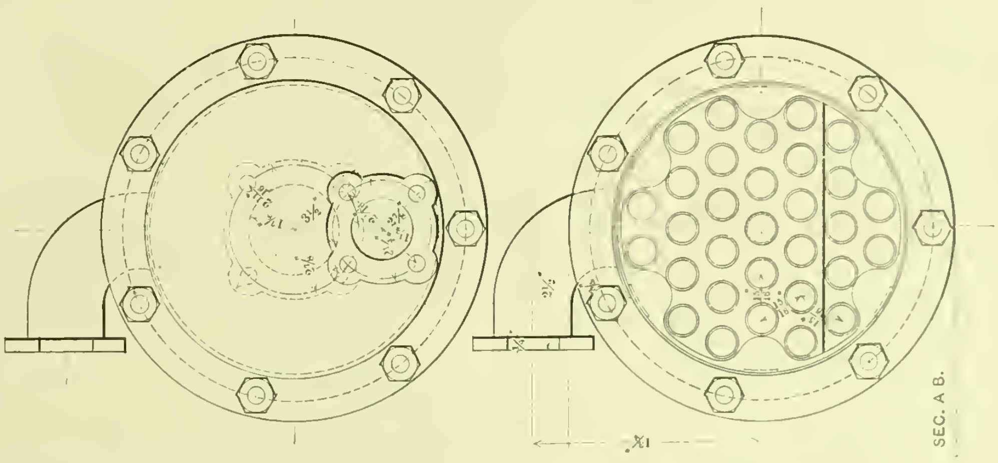
So long as the tool does not break it will certainly cut metal, but it is an awkward and unhandy substitute for a piece of tool steel, and costs more than double what the steel does. Moreover, it must have a special holder, but this will answer for several tools. This cutter cannot be dressed, and as it can be ground only, in case it breaks down from the point, it will cost a great deal more to grind it than to dress a tool. It is not a useful invention, but a "gimcrack," of no value in the shop.

◆

SMALL SURFACE CONDENSER FOR STEAM LAUNCHES.

In the engravings of the "Compound Steam Launch," recently published by us, a keel condenser was shown, but as some may prefer a surface condenser, we illustrate one here, from drawings by the Bureau of Steam Engineering, U. S. N., for engines of the same size as those shown in the launch.





The total cooling surface is 20 square feet, and the calculated weight, empty, is 74 lbs., with water 104 pounds. This is a light-weight condenser, and dimensions shown must not be exceeded. All the interior surfaces must be tinned.

◆

Why is it that it is more profitable to save the country than to engage in some legitimate business? Let the Sphinx answer, for surely no less oracle can. At this season, column after column of the city dailies is devoted to the chances of this or that petty officer, and to booming him for offices of one sort or another. It is an expensive matter to be elected to an office of any kind; the candidates spend good money and neglect their regular businesses—those of them who have any—and for what? Simply to get the name of Senator this or Sheriff that, and be at the nod and beck of the public, to have all their private affairs turned inside out, to hobnob with men they detest, and to be hail fellow well met with every idle Jack of the town! Verily, the way of the politician is hard.

◆

It is curious, when we think of it, that there is enough business for all if they will all work for it. The reason sane people do not get any is because they won't work. "He that will not work neither shall he eat."

SCREW PROPELLERS.

Upon the much discussed question of screw propellers, a correspondent of the *London Engineer* says:

The number of writers on the theory of the propeller is legion. At least half a dozen are eminent authorities. The unfortunate circumstance is that they do not agree in their conclusions.

Professor Fitz-Gerald, like all other mathematicians, assumes that water must behave in a certain way. He elaborates this behavior out of his internal consciousness for all the proof he gives to the contrary. Permit me to ask him if he has ever studied the performance of screw propellers in glass tanks. I have, and I cannot find that the action is at all like what Professor Fitz-Gerald says it is.

The late Mr. Fronde had certain theories about ship resistance. These would not fit in with facts, so he called to his aid an unknown quantity—eddies. In the same way, I find that the theoretical gentlemen always keep an eddy or two handy to throw at the heads of critics.

I knew the late Robert Griffiths well, and we had many a talk about propellers. He got some curious results at one time, and I remember his telling me that he had submitted them for explanation to a mathematical friend, who told him that his good results were due to getting rid of an eddy under the stern. We agreed that this was pretty, but we did not know what it meant.

Speaking once to a friend, who did a good deal with the microscope, I called his attention to some recent discoveries alleged to have been made in the United States. He replied, "My dear fellow, given a ½ in. objective, and a vivid imagination, and you can see *anything.*" So I say of propulsion: given a screw propeller, a vivid imagination, and a fair knowledge of mathematics, and you can prove anything. What superintending engineers want is a definite statement of how facts, or so called facts, are got at.

◆

Wm. Sellers & Co., of Philadelphia, Pa., have perfected a machine for grinding and shaping the faces of any kind of lathe, planer, slotter, and shaper tools. Tools brought direct from the blacksmith shop, placed in this machine, are ground and shaped in a comparatively short time to an exactness which would test the skill of an expert tool maker with an ordinary grindstone.

◆

The *Marine Review*, of Cleveland, will say in an early issue:

> "We regret very much that our bad photo cuts of the fine wood engraving of the '*Cushing*,' published in The Engineer, New York, was not duly credited to that paper, but owing to the absence of the proofreader and the foreman of the pressroom, it was overlooked. We promise that it shall not occur again."

Thanks: the apology is accepted.

◆

The Herreshoff Company, Bristol, R. I., have secured control of the manufacture of the Thornycroft water-tube boiler in this country.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

FROM NATIONAL VICE-PRESIDENT EDWIN W. TUCKER, M. E. B. A.

Editors ENGINEER:

I have intended writing THE ENGINEER for some time, and will now give your readers some particulars of my work since I left the East.

I was sent to Portland, Oregon, by Number 35, San Francisco, to settle a disagreement between our men and the Union Pacific R. R Co., and succeeded in upholding the dignity of the Order and making our point. At the same time, though, things were in a terribly mixed condition when I arrived on the scene of action. The trouble commenced by the railroad company attempting to reduce the crews of the steamers '*Lackme*' '*Michigan*' and '*Cosmopolis*,' which were manned by our men. They reduced the deck crowd, started on the engineers' department, and attempted to take the third engineer off, when two of the steamers called for three in their certificates. I found our men had been too hasty in leaving their vessels, and should have sailed under protest, and referred the matter to us, when the Arbitration Committee would have looked at the situation unbiased, and given them instructions what to do, which would have placed public sentiment on our side, showing them that we were gentlemen as well as engineers, and willing to support law and order.

I made several attempts to see the general manager, but he was out of town, as were the rest of the officials, it being Saturday afternoon when I arrived there. I finally had an audience with Captain Troupe, who has charge of the Ocean Division, and to make things come straight, I asked the local inspectors to accompany me and listen to my conversation. Captain Troupe told his side of the story, being very much put out at the way our men left the vessels, and wanted to know what redress they could get from us for causing extra expense and delay. In answering the many questions, I admitted to start with that our men had acted rather hastily, and done wrong in not sailing under protest, but the damage part I considered out of the question, and could not be admitted, for, in the first place, it was a matter of $75.00 on their part to allow the third man to go on her, when everything would have been delivered according to schedule, and it could have been paid under protest, but if they had rather unload their vessel, and ship everything overland at an enormous expense, it certainly was their privilege to do so.

The engineers of the '*Cosmopolis*' redeemed a great part of their mistake, as you will see later on. Seventy-two hours after being discharged, (having been relieved by a man named McIntosh, who took charge as chief engineer before Bro. Hanna left her), at 7:30 in the evening of the third day following, Bro. Hanna was met by the captain, who, almost out of breath, told him that the steamer was sinking, and asked him to come down and save her, so Bro. Hanna hunted up Bro. Kane, one of his former assistants, and they went down to her, and found five feet of water in the hold, and gaining at the rate of twelve inches an hour. They raised steam, pumped her out, and staid by her all night at the captain's request; pumped her out again the next morning, and left her, for which magnanimous action, the railroad company gave them one day's pay! The cause of the trouble was the disarrangement of the bilge and sea cocks, which would have soon put her on the bottom The company did not care to give us credit for this, and Captain Troupe said the only thing that looked suspicious was that the engineers were so easily found I told him that they could not get away very far in a city of that size if they wanted to. I also told him that we could claim salvage, if we were disposed to make trouble, but we were not looking for anything of that kind; it showed conclusively that our men were not vandals, and when property was in danger they saved it, where hundreds would have stood on the bank of the river and waved their hats while the ship went down. I then told Capt. Troupe if he wanted our men he must put them back as they were, but if he carried others he could do as he pleased, so long as he complied with the U. S. laws. I was treated very nicely by every one, and the inspectors did all they could to help me out. Mr. McMemott refused to alter the certificate to two engineers at the captain's request, as I entered a protest against its being done. He was formerly president of number 41.

We have just had another rattle with the Pacific Mail Steamship Company, they attempting to cut wages on the Ss. '*China*,' reducing the chief from $175 to $150; first assistant from $110 to $90; the second assistant from $90 to $80; and the third assistant from $75 to $.0 We had a called meeting, and decided not to accept any reduction, had an audience with the agent, and told him if he reduced the '*China*,' (although she was an English ship, and he might find a crew for her), we would take our men off every ship as she arrived. This meant about seventy men less to the P. M. S. Co., so they concluded to send the '*China*' out with the usual pay, which we have kept up for fifteen years, and intend to keep where it is. All the Eastern Associations will be notified not to send any men out here.

We ought to have a National officer on this coast all the time, and pay a man for his time, as he should be on call. What are your views on the subject? There are so many engineers here now that difficulties as they arise must be met at once, and handled to the best interest of all.

Sincerely yours in U. & F.,
EDWIN W. TUCKER, N. V.-P.
San Francisco, Oct. 11. M. E. B. A.

[We are very glad to hear from Worthy National Vice-President Tucker; he seems to have acted with good judgment and energy, and well represented the Order in the cause he was sent to adjudicate. The brothers in this section will be pleased to have him write again at his convenience.]

◆

GROOVED FLANGE JOINTS.

Editors ENGINEER:

In THE ENGINEER of October 18th you give an engraving and description of a new flange invented in England, which I claim is not only not new, and was not first invented in England. In 1883 I was in charge of a large plant on shore, and with one of the pipes leading to one battery of boilers, I had a great deal of trouble. A flange joint in particular was very hard to keep steam tight, in fact I had to make new joints every two weeks. I got a set of new flanges and put them in the lathe and grooved them, the same as shown in your cut, only I made the grooves with square edges. I then made the joint with Eureka cement, screwed it up tight, and that was the last of the trouble. I ran the plant for three years after that, and never made the joint again, and never had any leaks. Having occasion to be at the works last Winter, I asked the engineer in charge how the joint stood, and he told me it had never given him any trouble in over seven years. Now, I do not see how our English friend can claim the invention as his. I can furnish proof of what I say, as the engineer that is now running the plant was second engineer with me at that time, and saw me make the flange and helped put it together. Moreover, I can furnish the flanges themselves. I was going to patent the idea, but did not think it was worth while to do so. If there is any honor or profit to be got out of it, I do not propose to let our English friend have it. Please to note prior invention.

W. R. PATTERSON,
Engineer, Ss. '*Merrimac*,'
Milwaukee, Wis. I. O. T. Co.

[Brother Patterson's claim is, no doubt, valid enough, but it is too late now to patent it in this or any other country. It has been in public use over two years, and that settles it. It is very common to see old ideas patented, or things that have been in use much longer than two years, but such patents are valueless if anyone chooses to challenge them.—EDS.]

◆

SPRING OF RADIAL DRILLS.

Editors ENGINEER:

I see by a late issue of THE ENGINEER that you would like to hear from some one who has had experience with radial drills, as to their springing qualities. Some years ago, during my apprenticeship at the Old Colony repair shops, (Boston), I used to notice the operation of a radial drill which had just been erected. I observed that a great many tools, such as drills, counterbores, and others, were broken. As long as the operator was careful when feeding by hand, it would be all right, but the moment that the drill caught the arm would spring from the center and break the drill. In using a counterbore, when the first cut was on the "side hill," so to speak, we had to be very careful and not get what the boys used to call a bite; if we did, the tool was gone sure. For several years past I have spent my winters in a well-known marine works where there is a radial drill in use, without any of the above trouble. Much depends upon the design of the tool, and much depends upon the operator. All check-nuts that have been loosened so as to swing the arm into position must be tightened again before drilling another hole, to make a sure thing of it. In my mind they are one of the necessities in a shop where there are heavy castings to be drilled. A cylinder once in position can have all the holes drilled without moving it.

Steam yacht '*Clara*,' FRED S. BRADFORD
Ithaca, N. Y.

[We are much obliged to Mr. Bradford for his letter; but he does not say whether a radial drill can be depended upon to drill deep holes without binding of the drill.]

◆

A VOICE FROM CALIFORNIA.

Editors ENGINEER:

I have been using your paper for some time in my class of mechanical engineering and drawing, and all are so well pleased with it that we concluded to do what we could to raise your circulation, and enclose a list of names herewith The articles on boiler work have been duly appreciated, and those interested are hoping you will continue them. The same can be said of the engine work; I have four men at work enlarging the drawings of the launch engines recently published in THE ENGINEER. Hoping you will receive the encouragement you deserve. L. M.

San Francisco.

[Our correspondent takes the right course to secure our best efforts—by showing his appreciation of what we are trying to do. John Cook will please note what is said about his articles, and brace up again. Mr. Cook is employed as layer out of all the boilers in the Lake Erie Boiler Works, at Buffalo, N. Y., one of the largest concerns in the country, and if his articles are not right then the boilers the company makes are not right, for the articles set forth Mr. Cook's practice. There are no better boilers than those made at the Lake Erie Boiler Works, so John must be all right, q. e. d. We have some new features for 1891 which we think will merit the further good will of all.]

◆

DO NOT KNOW ONE.

Editors ENGINEER:

If you can without too much trouble, I would like you to recommend to me some reliable patent broker, or concern, that I can place a new invention with for sale. My patent is on a bicycle, and since getting the patent I have been flooded with gilt edged circulars from all over the world, and knowing the reputation these men have generally, I write you to see if you know of an honest one that you can recommend to me.

Worcester, Mass. G. H. D.

[Our correspondent does well to be cautious. We do not know any person who can be relied upon to act fairly in such negotiations. There may be some, but if there are they are not known to the world at large. Our correspondent should sell his own property, the same as he would any other merchandise. One way to do this would be to address makers of bicycles, and see if they can be induced to look at the improvement.—EDS.]

◆

TO WHOM IT MAY CONCERN.

To the Local Committee of the N. A. S. E.:

We the committee appointed to examine the vouchers and accounts for the entertainment of the delegates to the convention, find that the committee have received $5,505.40. and have paid out $5,448.88, leaving a balance in the hands of the chairman of the committee of $56.52, which amount we deem best to leave with him, until certain disputed claims are settled. Committee: H. M. Swetland, F. F. Hemenway, Randolph Brandt, John T. Maher, T. Thornton, W. H. Cronley.

[We publish this by request, but have not the least idea what it is about.—EDS.]

◆

THE ENGINES OF THE 'PLYMOUTH.'

Editors ENGINEER:

In your account of the trial trip of the '*Plymouth*,' published in your issue of the 18th inst., you should have said that the designer of the engines is Andrew Fletcher, President of the W. & A. Fletcher Co., as especial credit is due to him and not to me. By publishing this in your next issue you will greatly oblige,

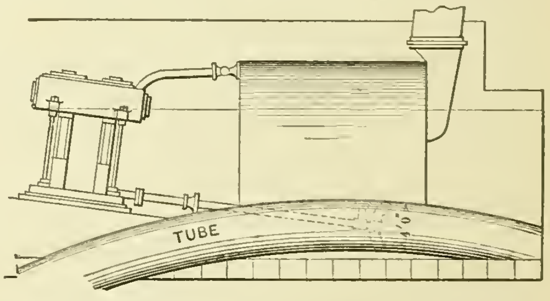
STEVENSON TAYLOR.

[We regret the error, but as no information was furnished the press, we ascribed the design upon "information and belief." Mr. Andrew Fletcher will, no doubt, accept our apology].

◆

A NOVEL SYSTEM OF SCREW PROPULSION.

THE '*Dhu Heartach*' is an iron vessel of the following dimensions: Length, 125 5 ft.; breadth, 18.0 ft.; depth, 9.8 ft; built in 1868, at Newcastle. She was originally a paddle steamer, having side-lever engines, the cylinders of which were 36 in. diameter by 48 in. stroke, the registered horse-power being 75 nominal. She is now fitted with twin screw engines, of the direct-acting inverted cylinder marine type, each about 12 nominal horse-power, the original boiler being retained in the ship. Each engine drives a two-bladed propeller 3 ft. 11½ in. diameter, revolving in a tube 4 ft. diameter, fixed to the skin of the vessel, as shown in the annexed sketch, the boiler being placed aft of the engines, and over the two tubes, as shown. The engine and boiler space is amidships, and it will be seen from the sketch that the original engine space has been left intact. The owners claim that a speed of 9 knots has been obtained, without any perceptible swell on the surface aft.—*Engineers' Gazette.*



◆

IF you want to make a little Christmas money send for circular to canvassers.

GAUGE GLASSES.

By George H. Ward.

This subject is one that ought to be particularly interesting to the engineer, for while it is generally recognized that these desirable fixtures should be a part of the furniture of every boiler, still they should be relied on only as an auxiliary, and not as infallibly indicating the true water level within our boilers

The true value of a water-gauge glass depends: first, on the method in which it is connected; second, to the proportions of its connections; third, its durability; and fourth, and most important point, that it will absolutely indicate the true water level.

The best practice would suggest that the steam and water connections thereto be of ample size, and in our judgment they ought never be less than one and a half inches; two inches would be better.

The connection on the steam side ought be taken either from the top of the shells or side of the steam dome, and not from a steam pipe leading from the boiler, as the draught of steam away from the boiler will likely cause fluctuation in the pressure within the pipe, and thereby cause a vibration of water in the glass, which is, of course, objectionable. Particular care should be exercised to avoid any traps in the pipe on the steam side; if any should exist there can be no reliance placed upon the glass. It is better to give a good pitch to the steam pipe toward the glass, as any condensation in the steam pipe will then be carried along freely to the combination fixture and mingle with the water therein.

The connection on the water side it is advisable to take from that part of the boiler where there is the least liability of its becoming fouled by mud or scale deposits; the bends should be as few as possible, and of long radius, when they cannot be avoided.

When right angle bends cannot be well avoided, it is better to substitute cross or tile fittings for elbows.

The pipes may then be easily cleaned and relieved from any deposit therein without the necessity of disturbing any of the pipe or fittings further than unscrewing the plugs, which may be removed with little trouble, if, previous to screwing in, they have been given an application of plumbago.

Gate valves ought to be invariably fitted as stop cocks to the connections outside of the boiler, should it be necessary with steam, or to take down or repair the combination fixture into which the gauge cocks and gauge glass fittings are generally screwed.

There should also be fitted suitable valves or cocks, so that the water column can be blown through on both steam and water sides; otherwise the connections are very likely to become wholly or partially plugged through the deposit of mud or scale therein.

There are several excellent devices in market for automatically notifying firemen of the fact of the water reaching either a dangerously low or high level.

This is accomplished by the blowing of a steam whistle, the fusion of a plug by heat, the ringing of a bell in connection with an electric battery, or floats within the boiler. Within certain limits, such fixtures are good, but as everything so-called "automatic" is liable to derangement and becomes inoperative, we do not think total reliance should be placed in them. Careful personal supervision by a competent man is the best preventative against the evils resulting from a dangerous fluctuation of the water level within steam boilers.

The question of durability of these fixtures is an important one, as, if properly attended to, the valves or cocks in connection therewith must be frequently handled, and for that reason the very best fittings in the market are the very cheapest. It may not be out of place here to analyze the various strains to which a gauge glass is subjected.

We find that while under pressure it is subjected to the combined effects of four distinct strains, viz.:

1st. Strain due to compression imposed upon the packing by the glands.

2d. A torsional, or twisting strain, due to the fact that both glands, being threaded right-hand, the adhesion of the packing material to the glass brings about such a strain.

3d. A tensile strain resulting from the same cause; and

4th. A bursting strain, while under pressure.

If the manufacturers of gauge glass fixtures will ever put upon the market their fittings, with the gland for the glass at the top threaded left-hand, and the one at the bottom threaded right-hand, they will find ready sale and eliminate the torsional strain imposed upon the glass when packed, and they will have earned the thanks of the craft, for more glasses are broken, many times over, from this cause, than legitimate wear and tear or old age. Here is a chance for the manufacturer to combine missionary work with business, for the old method of construction has caused more or less vexation of spirit, and the use of innumerable adjectives by the ungodly of our craft. Another objectionable feature in the construction of all gauge glass fittings that we have ever seen is that to the bottom fixture is fitted a (plug) pet cock. It looks very neat, perhaps, while new, but it is also another cause for the frequent use of adjectives by the men in charge of boilers.

We have never seen the pet cock referred to remain tight for any length of time. If the construction were altered so that a boss were substituted for the pet cock, and tapped for ¼ inch pipe, into which could be fitted a valve, the improvement would be welcomed by engineers at large. Likewise the plug screwed into the top of the upper cock of the better class of fittings, through which the glass is passed; this ought to be made solid instead of cored, as is the general practice.

The objection to cored plugs is that they are mere shells, and when put in fairly tight it is almost impossible to remove them after a short time without destroying them, the shell not being strong enough to withstand the twist of the wrench used in removing them.

A very important factor in the preservation of gauge glasses is the material by which they are packed, as well as the manner in which the packing is done. A pure gum ring, circular in section, is the best for the purpose, as by its use a minimum of pressure applied in screwing up the gland will cause the glass to be tight, and the limited surface of the rubber ring in contact with the glass materially reduces the torsional compression and tensile strains imposed upon the glass while screwing up the gland nut.

The packing to best perform the intended duty should be a close fit to the glass and neatly fill the space within the stuffing box or gland, as the case may be.

As before stated, we should consider a gauge glass as only an auxiliary, and put but little faith in it, particularly if it be not so piped that it and the pipes therewith can be and are frequently blown through.

Gauge cocks in the head or sides of the boiler, suitably placed, ought to be fitted, and these (in addition to those on the combination fixtures,) ought to be the means by which we determine the water level within the boilers.

Not the least important point about these fixtures is their get-at-ability, for the easier we make the firemen's water tenders, or the engineers' work, by placing these fittings where they are easily accessible, the oftener will they be tried, and less fluctuation of the water level within the boilers will result.

◆

Send for our circular of cash rates for subscribers. The Engineer is of interest to all, and you can get others besides engineers to take it

NOT NEW, BUT GOOD.

"There, I've got it down fine at last, and no mistake," said a Philadelphia business man, as he laid his pen down with a sigh of relief.

"Got what down?" asked a visitor.

"A new wrinkle adopted by merchants and others to prevent their names from being forged. After signing my name I turn the pen up and draw a line through it from right to left, and it looks as if the name had been cancelled. The peculiar little twirl at the end where the line commences is where the forger gets left. He doesn't tumble, so to speak, but the cashiers of the banks do, and they know instantly whether the signature is genuine or not. The line drawn through the name makes the check look as if it was no good in case it was lost, and the finder will not present it for collection. It's a great idea, and is being adopted by many business men of the city. Of course we have to explain it to the bank people, who, once they know it, have no further trouble with us over it."—*Philadelphia Paper.*

This is what the man means, and it is certainly good, because we have had post-office orders refused payment by the authorities until the matter was explained. We have used it for the last thirty-five years, so it is not very new to us.

"You will never have a check forged," said the cashier of the Nassau Bank to us, for no one on earth could write that name but you, as you do.

◆

A racehorse, Salvator, recently ran a mile in 1.35½. There are few who realize what terrific speed this is. It is nearly forty miles an hour—a rate averaged by very few fast railway trains. There are 5,280 feet in a mile, so that for every one of these ninety five seconds this wonderful horse covered fifty-five and three tenths feet of ground. The shortest space of time noted by the turfman's watch is a quarter of a second—an interval so brief that the mind can hardly appreciate it. Yet in every one of those 382 quarters of a second the magnificent creature leaped sixteen and three-tenths feet. Such are the amazing results of careful breeding as exhibited in the American racehorse.

◆

An indignant British brother writes to the *Engineers' Gazette*, and asks the following conundrums:

"Will any one inform me as to what a 3rd engineer's duties are on board ship; if they are to carry the 2nd engineer's tools for him and be his lackey? Is the 2nd supposed to keep everything under lock and key, viz. the stores, and use soft soap to wash his own clothes with and debar the 3rd from using it? Likewise to use all the new files him-self and try to make the 3rd use all the old ones? Are the above things right or wrong? Locking everything up, even to the lampwick? Never in any ship before have I seen it done, having been to sea twenty-eight months as 3rd."

◆

The new steel boilers for the '*City of Sydney*' are now complete at the Risdon Iron Works, San Francisco, Cal., where they were made, and are thoroughly first-class. They are six in number, 13 ft 6 inches diameter, and weigh over 200 tons. They will develop 3,000 horse-power, and are constructed in accordance with the most advanced modern practice. They are Scotch boilers, and the figures show that they weigh, empty, over 133 pounds per h.p., which is a very great weight.

◆

The Engineer has been printed on very inferior paper lately, through no fault of the publishers, who paid for the best and got something else. Readers will see an improvement in this issue.

◆

Only one person in 1,000 dies of old age.

THE ENGINEER.

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Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK, OCT. 25, 1890. No. 9.

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COMPOUND AND TRIPLE EXPANSION ENGINES.

THE interest which attaches to high expansion engines is by no means transitory, for inquiry into them and experiments upon them are made constantly. Now, these engines are in themselves exactly like all others. There is no difference in the mechanism or the action; they are simply engines with either two or three cylinders set up in line and working on the same crank-shaft, with cylinders of different diameters. In the triple cylinder engine, the first one exhausts into the second one (the intermediate), and the second exhausts into the third (the low pressure), which last exhausts into the condenser. That is the whole system as regards the mechanical action and construction, and there is no complication about it, except as regards the increased number of parts. When we come to the principle, however, or the action of the steam in passing through so many cylinders, and inquire into the cause of economy, we are confronted with so many contradictions that it is not wonderful that engineers are puzzled. There are a great many discussions in technical societies, and a great many papers written upon this or that aspect of the high expansion engine, and the causes of profit or loss are by no means fixed. That they are more economical than single cylinder expansion engines seems settled, though there are not wanting capable engineers who do not admit this even.

One point insisted upon by the advocates of the triple cylinder high expansion engine is that they shall have a high piston speed; in other words, run fast, so that the condensation of the steam in passing through several cylinders shall be lessened, but there are two cylinder compounds which run at very low speeds (pumping engines, for instance), and these exhibit marked economy over single cylinder engines. It is very difficult to say what high piston speed is, or fix a boundary line between it and low piston speed. If the effect on the cylinder is to be considered, there is no difference in high and low piston speed upon the economy, unless the dimensions are taken into consideration; for a 12″ piston with a 12″ stroke, working in its cylinder at 60 revs. per minute, heats that cylinder twice in a minute, and makes only 120 feet piston speed, while a 40″ cylinder with 5 foot piston stroke at 60 revs. per minute, also heats its cylinder twice in a minute, but makes 600 feet of piston speed in the same time that the 12″ piston makes 120 feet. One cylinder is heated just as often as the other, but one piston runs five times faster than the other. It would seem, therefore, that high and low piston speed has no meaning unless we qualify the application of it by dimensions.

There is a great difference in the economy of high and low piston speeds in the same engine, however, and it is found that triple expansion engines are not economical except within certain limits. It is easy to see that at some grades of expansion the low pressure cylinder gets no steam. Cutting off short in the high pressure, and exhausting what remains into the intermediate cylinder, turns the three cylinder engine into a two cylinder engine for the time being, while the third cylinder acts as a brake, for its piston works against the pressure of the atmosphere. For this cause some triple cylinder engines in war vessels are so fitted that they can disconnect the third cylinder and use two only for cruising at low speeds.

We incline to the view that the economical speed of each triple expansion engine will have to be fixed for each system, or for each set of engines, and that no rule can be established which will apply to all. This for the reason that no two engines by different makers are alike in their plans. These materially affect the action of the steam as to its highest efficiency.

◆

AN inch of rain means 100 tons of water on every acre.

PROFESSIONAL INTEGRITY.

IN the course of his address to the American Society of Civil Engineers at its last convention, President W. P. Shinn offered the following important advice regarding the giving of expert testimony and opinions:

> "Nothing can be more unseemly than to see two eminent members of any profession, each trying to earn his fee by stating such facts or giving such opinions only as make for the side by which he is retained. The differences of opinion which naturally must exist are thereby stimulated and intensified until all respect for scientific opinion is lost by the laymen who have no knowledge of the subject. It has long been my opinion that the expert witness should be called by the court, and that he should be allowed to state facts and opinions freed from the trammels of the "*Suppressio Veri*" so often employed by the attorneys on either side. It might result in some of my professional brethren receiving less fees, but it would be to the benefit of the profession and the cause of justice."

A contemporary who copies this adds upon his own account that it applies equally well to mechanical engineers. Perhaps it does, in his experience, but it certainly does not in ours in similar cases, of which cases we know very many. Not long since, a well-known locomotive engineer in this city was called upon to report a test of a new patent locomotive, which was "capitalized" as usual, for a large sum. The engineer made the test, found the engine wanting, and said so in his report. This so amazed the inventor of the locomotive that he carried the report around with him and showed it to the public as an example of the incapacity of the expert, who did not know a good thing when he saw it.

"And we paid him $740 for it, too," said the inventor.

Another young mechanical engineer in this city, who is making a reputation, said upon this very point we are discussing: "I have lost a good many clients simply because I made up my mind at the beginning of my career that no company could buy me for a price, high or low." Doubtless such instances could be cited by many other persons, and it is true as a rule that mechanical engineers are true to their profession and themselves.

As for attorneys who are employed in technical cases—of course they suppress the truth. That is the object of employing them. One or the other contestant knows that he has a poor show, but he does not relinquish his real or pretended rights by any means—far from it. He simply hires the best lawyer he can get to bamboozle and befuddle the case into a semblance of right. Simple people still suppose the function of the lawyer is to expound the law and carry it out, when the function of the lawyer is to bulldose and confound the truthful witness and try to make him tell lies if he can.

We do not know a mechanical engineer of the present time who could be retained to commit professional suicide.

◆

CONCERNING TRIPLE SCREW SHIPS.

THE new experimental vessel of war to be built by the Government is to have three screws, one on each quarter and one amidships, and much speculation has been made upon the probable success of the arrangement. Concerning triple screws as a system Horace See, a well known marine architect and constructing engineer of this city, says:

"The engine is built to secure extreme speed. This means, with the use of the single screw, a reduction of revolutions at low speed, and with it a proportionate increased coal consumption per horse-power employed per hour. It is possible with twin screws to improve on this either by duplicating the engines on each shaft, discontinuing the forward set when low speeds are desired, and running the after ones at full speed, or by running the port or starboard engines separately at full speed.

"With triple screws we can go still further than this. By their use the speed can be cut down in two ways, either by running the middle screw alone or either one of the outside screws separately at full speed. The idea of running the middle screw separately has governed the adoption of the triple system in the 7,300 ton cruiser to be built for our navy. Some, points, however, in their application to this vessel are open to criticism. I refer to the position of the outer screws and diameter of the middle screw. If in dropping or diverging the screw, the shaft is inclined or the centers at the wheel made greater than at the engine, its pitch will vary through every part of its revolution in proportion to the amount of inclination. Consequently its action will be irregular and the speed of the ship retarded.

"By making the middle screw less in diameter than the outer ones we shall have this vessel of 7,300 tons displacement propelled, if the engine is worked up to its full natural draught power, by a twelve foot screw, to which about 5,000 i.h.p. will be applied. This will no doubt act with some loss of efficiency and consequent waste of fuel, so that the end aimed at will be but partly secured. If, however, it is correct to employ such a small diameter here, it is wrong in merchant practice to employ a sixteen or seventeen foot screw to do work of a similar character.

"The rivers of our country, on account of shallows in some places, present a field for the use of the multiple screw as great as that on the ocean, so that we shall await with some interest the building and trial of this vessel."

◆

ARTIFICIAL COLD AND REFRIGERATING MACHINES.

By Charles Exstrand.

All objects are pervaded by latent or in sensible heat. Capacities for heat differ; one solid will retain more than another, liquids more than solids, and gases more than liquids. If their volumes are compressed, their retaining capacity is proportionally diminished. If ten parts of gas are compressed into one part, the heat of nine is evolved and driven off, and there results a loss in the remaining tenth, due to the fact that its increased density has decreased its capacity for retaining its latent heat. This is the principle on which mechanical refrigeration is established.

The agents employed are several, among which may be mentioned air, sulphuric oxide, carbonic acid, methylic ether, nitrous oxide, and ammonia.

Of all these, ammonia has been most generally adopted, as it has been found, when compared with the other agents, to be more efficient, absolutely safe from explosion, fire, and corrosion of metals. It is used either in its pure state, and is then called anhydrous, or saturated under the name of aqua ammonia.

Ammonia derives its name from Jupiter Ammon, in consequence of its having been first procured from the salt obtained by the ignition of camels dung, near a temple of that mythical deity in Libya. In the uncombined state, ammonia exists in the juices of certain plants, and in a state of combination it is found in variable quantities among the saline products of volcanoes, in sea and rainwater, in bituminous coal, in urine, in guano, in the excretæ of animals and reptiles, and in the atmosphere—especially that of large towns. It is freely developed during the decomposition of azotised vegetable substances and the putrefaction of animal matter. The ammonia of commerce and its salts are generally prepared from the ammoniacal liquor of gas works, as well as that obtained from bone and animal charcoal factories. It is a compound of three volumes of hydrogen and one volume of nitrogen, condensed into two volumes, and consists by weight of 82.35 parts nitrogen, 17.65 hydrogen. Its specific gravity is 0.589. 100 cubic inches weighs 18.26 gr. Under a pressure of 6.5 atmospheres, at 50° Fahr., it forms a transparent colorless liquid of the specific gravity 0.731; at 60° Fahr., this liquid expands into 1,009 times its volume of ammoniacal gas. At 40° below zero, and under ordinary atmospheric pressure, it liquifies, and at 108° below zero it freezes into a white, translucent crystalline substance. The latent heat of ammonia is 860°. Water at 50° Fahr. absorbs 670 times its volume of ammonia gas. This solution is called aqua ammonia. It boils at 130° Fahr., and freezes at 40° below zero.

Refrigerating machines are divided in two classes, viz., the absorption system and the compression system. The absorption machine was invented by Carré, of France in 1858. Aqua ammonia is exclusively used with this system. In operation, the absorption machine starts with aqua ammonia, which is heated in a boiler or still until the gas is expelled from the water within a retort, and compressed there by natural accumulation until it acquires sufficient pressure to force it through a small pipe into the condenser, where it is cooled and liquefied, being surrounded by cold water. It is then allowed to re-expand to a gaseous state in coils surrounded by the substance to be cooled. The gas having done its work of refrigeration is led through a pipe to an absorber, where it meets the water (mother liquid) left behind in the retort, which, meanwhile, has gone to the absorber for the purpose of re-union. After they are united, the product becomes the original aqua ammonia; it is pumped back by a small force pump or injector into the retort, to resume its work. The only power required for this machine is that necessary to operate the pump, which is driven by steam, and sufficient steam to boil the aqua ammonia. The inventor of the compression system is Professor Twining, of New Haven, Conn. In this system, the various agents before mentioned have been experimented with, but the most generally used is anhydrous ammonia. The apparatus consists of an ammonia tank or receiver, expansion cocks or valves, expansion coils, compressors and condenser. The work is done either by direct expansion or by what is termed the brine system. In the direct expansion system the expansion coils are placed directly in the rooms to be refrigerated. In the brine system the expansion coils are placed in a tank containing brine (a solution of common salt and water at 100° density), which when cooled is circulated by means of a pump through coils of pipe placed in the rooms to be refrigerated, and finally returned to the brine tank, making the operation a continuous one.

The operation of the compression system can be divided into three parts, viz., expansion, compression and condensation. The liquid ammonia in the receiver is allowed to pass through the expansion cork in small quantities into the expansion coil, and on being relieved of its pressure, instantly evaporates into a gas. During evaporation all the latent heat lost during liquefaction is again supplied to the gas from whatever substance that surround the expansion coil, and since the boiling point of ammonia is about 28½° below zero, it will absorb heat from anything above that temperature.

The expansion coil terminates in a suction pipe leading to the compressors; here the gas is again subjected to pressure and allowed to pass into the condenser, which is a series of coils, over which cold water is allowed to circulate, or in some instances immersed in water. There the gas is again cooled, all the heat collected during expansion is given off, and it passes from the condenser in liquid form into the receiver, again to perform the same operation.

The pressure in the condenser depends on the temperature of the water available; the cooler the circulating water is the less pressure is necessary to liquefy the gas, and as the temperature of the water increases, the pressure will increase. It usually ranges from 120 to 160 lbs. per square in. The amount of cooling done depends on the quantity of ammonia evaporated by weight, not by volume.

One pound of ice, melted to water at 32° Fahr., absorbs 142 heat units. Practically it has been found that one pound of liquid ammonia, in evaporating, absorbs about 568 heat units, so in cooling capacity one pound of ammonia is equivalent to four pounds of ice.

◆

WRONG.

Last week a man came into this office looking for a situation; he produced a circular letter signed by a well known name, written on the letterhead of a large and powerful concern; he also brought a very powerful atmosphere with him, and ended by requesting the loan of a few cents. Now, if this man was the lawful owner of the certificate he held it was wrong to give it to him. He was an old man and no stranger to drink, and the only use he could make of such a circular would be to abuse the confidence of the men who signed it. Surely those who appended their names to the document in question would have felt their cheeks tingle if they had seen this man when he presented it to us! Do not give any one the use of your name unless you know him to be worthy. Do not recommend disreputable men for any situation. It is not just to men who are striving to be respectable members of the community to give letters of recommendation to sots.

◆

In 1889 five steam pipes were burst. Three of these were of cast-iron, and their failure was attributed to the "water hammer" action, *i.,e*, through the water therein, produced by condensation, not being properly drained off before steam was admitted. Two of these failures were accompanied by fatal results. In another case a large copper pipe at an electric lighting works failed in a similar manner, causing the death of one person and injury to ten others. The workmanship in this case was stated to have been defective: but the failure was attributed chiefly to the action referred to. A steam pipe connected with some colliery boilers burst in a similar manner. Mr. Henry Hiller, engineer to the National Boiler Assurance Company, very properly says: "All these cases manifest the great importance of steam pipes being arranged so that the liability to accumulation of water may be avoided. If this is unavoidable, special care should be taken to drain the pipes thoroughly before admitting the steam."

◆

One sometimes regrets that aluminum was ever discovered; for it has given the amateur an opportunity to disport himself in airing his impossible ideas in an astonishing number of unnecessary words.

In a recent issue of the *Chicago Journal of Commerce* was given the assertion of Mr. John Lockie, of Leith, Scotland, who held that shipbuilders have about reached the maximum of speed unless there is a change in structural material Another correspondent of the same paper, in a later issue, takes a different view, as follows: "Undoubtedly the mechanic art has been expending itself largely on perfecting construction, taking things as they are, rather than seeking new combinations and devices of material; hence it has approached the limit of its calculation in regard to weight, strength and speed, and it calls for the lighter and stronger metal of the future to do more, and he wants to make a steamship of aluminum.

◆

In a drama recently put on the stage in this city realism is carried to excess. In the course of the play one of the actors is knocked senseless on to the carriage of an actual saw mill, with five-foot circular saws driven by an 8 h p engine The saws cut through an inch plank and are close on to the actor before he is rescued It requires much nerve to be unconscious next door to a five-foot circular saw in operation.

◆

This is cut from an Eastern paper:

"Some time ago we took a subscriber in the office and $2, and wrote the name E. L., Blanktown, Mass. Will the gentleman at Blanktown please give his correct address so we can send his paper."

Not bad, eh?

Foreign and Domestic Trade Literature

THE PROCESSES OF STEAM IN ITS DEVELOPMENT OF POWER BY MEANS OF A STEAM ENGINE.*

BY CHIEF ENGINEER B. F. ISHERWOOD, U. S. N.

The latent heat of a pound weight of saturated steam is the measure of its *vis viva* in units of heat. The molecules of the steam must be endowed with that quantity of *vis viva* to remain in the form of steam. Now, as more *vis viva* or heat, (exclusive of the heat transmuted into the external work of expansion), is required to keep the molecules of expanded steam in the state of steam under lower, than under higher pressures, the quantity of *vis viva* in the expanded steam will be insufficient to maintain the whole of it in the form of steam, and the excess must lose its *vis viva* and liquefy. This excess admits of calculation. There must liquefy such a fraction of the weight of the expanding steam as the difference between the latent heats of the steam before and after expansion is of the latent heat before expansion. This quantity of liquefaction takes place in all cases of expanding steam when the steam remains saturated during the expansion. The fraction in pounds of the weight of the expanding steam thus liquefied, by what may be called its expansion *per se*—a liquefaction additional to the liquefaction due to the transmutation of part of the heat of the expanding steam into the external work of the expansion—multiplied by the latent heat of the steam before expansion, gives the number of units of heat transmuted into the additional *vis viva* required. The quantity of heat thus transmuted depends obviously on the degree to which the steam is expanded, and the pressure from which it is expanded, but under the average conditions of practical steam engines, it will be found a very serious quantity exerting a marked influence on the economy with which the power is developed.

The following question must now be answered: In what state is the water of liquefaction due to the expansion of steam *per se* to be found, and how is this liquefaction distributed among the molecules of the steam?

Steam is composed of hydrogen and oxygen, and its simplest conceivable molecule would contain two atoms of the former and one atom of the latter; but the real steam molecule is doubtless a group of such simple molecules linked together in an unknown manner and acting as a unit. The molecule is acted on by a certain force, which maintains it at a determinate speed, its *vis viva* being represented by the product of its mass into the square of its speed. If, now, (say) one-half the mass be detached, the impelling force remaining as before, the remaining half mass will move with increased speed, and will have a corresponding increase of *vis viva*. This is what takes place with steam when it expands; every steam molecule undergoing partial liquefaction; that is, liquefaction of one or more of the simple molecules composing it, in order that the remaining simple molecules of the steam molecule may receive the necessary increase of *vis viva* for maintaining them in the form of steam. Always, when saturated steam expands, with or without doing external work, this molecular liquefaction occurs, and in proportion to the measure of the expansion. The more the steam is expanded, the more of the simple molecules composing the original steam molecules will be liquefied. Expanded steam is thus wet steam, and wetter in proportion as it is more expanded. Further, it is the only kind of wet steam. This water of liquefaction being in infinitesimal drops or masses, will long remain suspended mechanically in the remaining steam, rendering the latter opaque and giving it the appearance of haze, mist, fog, or cloud. With sufficient time, however, these inconceivably small drops of water would precipitate by gravity upon the surfaces beneath them, but their descent through the resisting medium of the steam would be so exceedingly slow that in the case of the steam engine this precipitation never occurs for want of time, and the liquefied simple molecules are swept through the engine without sensible deposition. Unexpanded steam is always transparent; it is an invisible vapor; nor is its invisibility affected by mere mixture with it of additional water of the same temperature, as in the case of boilers priming or foaming. The primed or foamed over-water constitutes a distinct mass, side by side with the steam, but not intimately mingled with it, and separable almost instantly by gravity. The steam itself in this case is not wet.

Until the constitution of matter and the forces which produce the movements of its atoms are exactly known, the precise conditions of no physical problem can be given, but even with vague generalizations, confirmed by experiment, some approach can be made to a decision. Above all, in order to understand the action of any force, we must be able to form material conceptions of its operation, without which tangibility we cannot have any real grasp of the subject.

There remains a second cause of liquefaction of expanding steam in a steam engine, namely, the external or commercial work done by that steam, including overcoming the back pressure against the piston; this liquefaction is directly proportional to the heat transmuted into the work done by the expanding steam, counting that work down to the zero of pressure. In other words, the foregoing deals with the consumption of heat, or of *vis viva*, connected with the transference of heat or *vis viva* from some of the molecules of the expanding steam to the remainder, in order to maintain the equilibrium of the latter after the expansion, the action being wholly internal to the steam, and neither affecting nor being affected by the external work done by the expanding steam; but when steam expands against an external resistance it does external work, undergoing thereby a corresponding loss of heat, and suffering an equivalent liquefaction.

The steam molecules strike the piston with a *vis viva* represented by the product of their mass into the square of their mean velocity. The loaded piston being free to move, yields to the impact, and in moving takes up a portion of the *vis viva* of the striking molecules, which of course lose exactly that portion, having transferred it to the piston. As regards the steam in the cylinder previous to the commencement of its expansion, this loss of *vis viva* is instantly restored from the boiler (at the expense of the fuel), so that no liquefaction of steam takes place in the cylinder from this cause previous to its expansion, the loss of heat being transferred from the cylinder steam to the boiler steam, which continually receives fresh accessions of heat from the burning fuel. There is a real liquefaction of steam in the boiler corresponding to the heat equivalent of the work done in the cylinder previous to the expansion of the steam, but the water of this liquefaction is instantly revaporized in the boiler by the fuel. But when the steam commences to expand, after the closing of the cut-off valve of the cylinder, it is separated from the boiler steam, and can no longer receive accessions of *vis viva* or heat therefrom; consequently, all the heat transmuted into the external work of the expanding steam has then to be taken from that steam itself, which undergoes a resulting liquefaction corresponding to the heat or *vis viva* transmuted into this work. When expanding steam does external work, it not only partially liquefies correspondingly to that work, but that liquefaction is accompanied by the additional liquefaction due to the increase of the latent heat. The greater the expansion the greater the liquefaction from both causes. The temperature of expanding steam, when that steam remains in the saturated state, as it does when performing work, decreases with each increase of expansion; and, when it falls to something less than 32° F., it changes into water; the liquefaction has become total, and that is the physical limit of the expansion of saturated steam.

The quantity of heat or molecular *vis viva* transmuted by expanding steam into the external work developed by the expansion can be calculated. Accepting 789¼ foot-pounds of work as the mechanical equivalent of one Fahrenheit unit of heat, the division of the number of foot pounds of work done by the expanding steam, by 789¼, gives the number of Fahrenheit units transmuted into that work, and if this quotient be divided by the mean latent heat of the expanding steam, the quotient will give the number of pounds weight of steam liquefied to furnish this quantity of heat.

The number of foot-pounds of work done by the expanding steam must be obtained experimentally (by an indicator in the case of the steam engine), as the curve of the expanding pressures cannot possibly be calculated, even under abstract conditions, much less under the practical conditions of a steam engine.

From the moment the steam begins to expand there are simultaneously a continuous molecular liquefaction of a portion of it, and a continuous diminution of its temperature, both of which tend to lessen its pressure. There is, also, during the expansion portion of the stroke of the piston, a continuous evaporation of steam from the water of liquefaction due to the heat interaction of the metal of the cylinder with the steam, and this evaporation tends to continuously increase the pressure. Now if the lessening of the pressure by the molecular liquefactions were exactly compensated by the increasing of the pressure by the steam of the revaporized water of liquefaction due to the interaction of the metal of the cylinder, the curve of the pressures of the expanding steam would exactly follow the Mariotte law. Again, the molecular liquefactions and the decrease of temperature are caused wholly by the expansion of the steam, and the interaction of the metal of the cylinder is likewise caused almost wholly by the expansion of the steam, so that if all the water of liquefaction due to the interaction of the metal were revaporized during the expansion portion of the stroke of the piston, which, in general, is the fact, and if all the molecular liquefactions took place during the same portion of the stroke, the two should counterbalance each other, for they stand in the relation of cause and effect. But all the molecular liquefactions do not take place during the expansion portion of the stroke of the piston; some liquefaction takes place during the exhaust stroke, caused by the expansive expulsion of the steam from the cylinder after the opening of the exhaust port, and some liquefaction takes place due to the transportation of the steam from the boiler to the cylinder. In general, the steam evaporated from the water of liquefaction due to the heat interaction of the metal during the expansion portion of the stroke, exceeds by a very variable fraction (sometimes very small and sometimes quite large, according to the regimen of the steam) the molecular liquefactions during the same portion of the stroke, so that the pressures given on the indicator diagram by the expanding steam rise higher and higher above the pressures due to the Mariotte law, as the piston advances, until at the end of its stroke the difference is the greatest. When the steam is used without expansion in medium sized and large cylinders, it experiences but very little liquefaction.

(To be continued.)

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* A lecture delivered before the Sibley College of the Cornell University, Ithaca, N. Y.

EVIL OF BLOWING DOWN MARINE BOILERS.

No doubt there are many young engineers anxious to know the best way to preserve, and the most economical way to work, a marine boiler. It is not an easy matter when he has to serve under half dozen, more or less, chief engineers, not any two of whom work the boiler alike. The first tells him not to allow the density to exceed $\frac{2}{32}$ at 200 degrees Fahr.; not to blow down the boiler on arrival in port until the steam is down to 25 lbs.; never to open tubes, doors, etc. The next tells him the density must be kept at $\frac{3\cdot5}{32}$, but on no account to exceed that, as it is dangerous; never allow the safety valves to lift, and, if you cannot check the steam with the dampers, open tube doors; on arrival in port blow down the boiler with full working pressure, for if the steam gets low the boiler will vibrate, and cause the seams to leak; use plenty of lime, etc., etc., in the boiler. Other engineers have a craze for using soda, quite irrespective of the nature of the water they are using, or the state of the boiler internally. For instance, a chief on his arrival home was told that he was making very long runs, when he replied that he could not drive the engines, because the boilers were priming badly, and valves grunting fearfully, and all the cocks on boiler were in bad condition, etc. This steamer was eight years old, and the boilers had never primed before.

After investigation, the chief was asked if he had been using soda, when he answered: "Oh, yes! I put soda in the boiler every day." And, to make matters worse, he was using river water from tanks all the voyage. The use of soda should always be accompanied by frequent and regular scumming down to prevent priming and all its accompanying evils. Soda thickens the water, and should there be greasy matter in the water, the application of soda will cause the water to foam and produce an increased amount of fine grit and powder, which float on the surface. This getting into the cocks causes them to leak, and it is also carried away by the steam into the engines, cutting the slide valve and cylinder faces, causing great increase of friction, besides destroying the packing, etc. Therefore, soda should not be used except when absolutely necessary, and then in very small quantities. A little soda put into the boiler on arriving in port will loosen the incrustation, but be careful that the grit does not get through into the engines. Before leaving this subject I should like to draw the attention of engineers to the necessity of getting the best soda, as inferior contains acids which causes corrosion, and is very injurious to the boiler plates. There is more waste in blowing a boiler down than is considered by many engineers, and to blow a boiler down when the density has only reached from $\frac{1.5}{32}$ to $\frac{2.5}{32}$ on the salinometer, when it can be worked with perfect safety at a density of $\frac{3.75}{32}$ or more means a very serious loss. It should be borne in mind that the salinometer does not show the nature of the ingredients which make up the density of the water, but only the density. Thus, if the water should contain oil, mud, or other matters, they will affect the salinometer; besides, it is not the high density that causes heavy incrustation and scale, but the frequent changing of the water.

By way of illustration, take a steamer sailing between Liverpool and New York, the passage occupying ten days. On leaving, the density of water in the boiler was $\frac{3\cdot5}{32}$ (we will take one boiler, 20 in. × 19 in., with six furnaces, three combustion chambers, ordinary boiler, and evaporation). The first day out the chief gives orders that the water in the boiler is to be blown down 12 in. every day, so as to keep the density from rising. By doing this, he deposits in the boiler 464 lbs. per day, or, during the passage, 2 tons 1 cwt. 1 qr. 20 lbs. of what is commonly called salt. Taking the boiler to be in good condition, and no more than ordinary leakage about pumps and glands, etc., the density would rise on an average about $\frac{\cdot025}{32}$ per day, and if the chief had only worked the density up to $\frac{3\cdot125}{32}$ he would have effected a great saving in in heat, fuel, and labor. Some one may say: "But you blow out as much brine (or salt) as you put in." Just so, if the whole of the solid ingredients that entered into the boiler were suspended equally throughout the whole body of the water in the boiler, but such is not the case. All matter, except the salts of soda, is precipitated by raising the temperature. The sulphate of lime, the most troublesome to remove, is not long held in suspension, and this deposit seriously detracts from the heat-conducting power of the plates. The heat-conducting power of scale being only about $\frac{1}{13}$th of that of metal. Again, some one will say you burn much more coal by allowing the density to rise so high. Much less than the usual amount; as the difference of boiling point between $\frac{1}{32}$ and $\frac{3\cdot5}{32}$ is only 3 deg. Fahr.; that is, water with a density of $\frac{1}{32}$ boils at 213.2 deg., and of $\frac{3\cdot5}{32}$ at 216.3 deg. Fahr., while the loss through blowing down is 132 per cent. of fuel used per day ×1.51 per cent. of the total heat in the boiler, and the loss of fuel caused by incrustation is from 15 to 20 per cent. for a thickness of $\frac{1}{16}$ in.

Expansion and contraction may be considered among the most important matters concerning large boilers. Forcing the fires to get up steam quickly, and blowing down the boiler on arriving in port, when the plates and brickwork are at high temperature, turns a new boiler into an old one sooner than anything else, as it leads to grooving, leakage at tube ends, seam, and rivets in combustion chamber, and besides strains the plates. It has even been known to rip the ring seams of rivets at the bottom of the shell, through exposing the boiler to rapid changes of temperature. Take for instance, the before-mentioned boiler; it will take to build one bridge, 1,292 lbs. of bricks and 2 cwt. of fire clay, and for the three bridges, 1 ton 19 cwt. 22 lbs. This boiler is blown down on arrival in port to the salinometer cock, and that as soon as the fires are drawn, with a steam pressure of 80 lbs. per square inch and a temperature of 312.0 deg., and with the before-mentioned mass of bricks and clay, and the bar-bearers red hot; and as brickwork is a bad conductor, or a good retainer, of heat, if follows that while the upper part of the boiler is cooling down quickly, the bottom parts are kept at a high temperature by conduction and radiation from this great mass of bricks, etc.

Say that the temperature at the bottom is 180.0 deg Fahr., and that at the top 90.0 Fahr., taking the temperature of the air outside of the boiler at 50.0 deg. Fahr., the expansion at the top will be equal to .0673, and that at the bottom .2214, the difference of expansion being .1542, which throws a strain of nearly 8 tons on the plates. Too much care cannot therefore be taken to keep the boiler at an even temperature. Again, if the boiler is blown down, while the plates, brickwork, etc., are at high temperature, the sludge, that is the deposited sulphate of soda, carbonate of lime, etc., especially the latter, are baked into a very hard crust or scale, and cannot be removed without the use of scaling hammers, which means delay, labor, and expense. If the water is allowed to cool down in the boiler, the deposit will be found as fine powder, and the scale previously formed on the furnace, etc., cracked and loose, and easily removable. The water should never be blown or run out of a boiler when the plates, etc., are at a high temperature, but in case of emergency cold water may be pumped into the boiler to mix with the hot, so as to cool it down gradually and generally, and not suddenly and locally.—*W. O. Hughes, in Engineers' Gazette.*

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FACTS CONCERNING EMERY WHEELS.

NOTHING has cost emery wheel users so much loss as their false estimate of the money value of durability. It may be possible to get an emery wheel so friable that its rapidity of wear is not equaled by its increase of product; but this investigation seems to show that the majority of American wheels are too durable and too unproductive. The average metal removable of all the makes, at a fair, ordinary working pressure, was 1.42 ounces per minute, but out of fifteen makes ten fell short of this average.

While the consumption of wheel material does not bear a regular proportion to the amount of metal ground, yet, as a general rule, increased wheel consumption implies increased product. So marked is the rule that it may be safely assumed that any wheel which is notable for its durability will be a markedly slow grinder.

If we seek for an intelligible reason why the workman should prefer a slow cutting wheel, we can find but one, and that is, that sometimes it appears to minister to his laziness, and afford relief from the strain of continuous work. But this is an appearance only and a sham.

We have stated that the average metal removal per minute of the fifteen make was 1 42 100 ounces, and that 10 fell short of this average. This average, however, was at what we call a fair, ordinary pressure. Now, in many cases the workmen is not satisfied with the small product, and to secure a greater, applies more pressure. This pressure soon exhausts him, and he then gets rest and change of work by stopping the machine and proceeding to chip or hack the face of his wheel. This investigation shows that some of the so-called very durable wheels largely increase their product if a great pressure is applied. We cite, as illustration, the case of one well-known and popular make, whose average metal removal per minute, at a fair, ordinary pressure, was only 72-100 of an ounce, but which, when the pressure was increased about 2½ times, attained an average of 7 9-100 ounces. The maximum metal removal of this wheel in any one minute was 11 66-100 ounces, yet in some cases its minute metal removal was absolutely nothing. The pressure which secured the average of 7 9-100 ounces per minute was an excessive pressure—a pressure at which some makes would be dangerous in the extreme and which no workman could maintain. It is to obtain rest, and change from the too heavy work necessitated by extra durable wheels, that men gladly accept the job of chipping and hacking a wheel. How much time is thus lost, and how much wheel material wasted, it is impossible to say, and equally incalculable is the waste of physical effort in striving by undue pressure to exact a reasonable product from an over hard wheel.

If wheels were provided which gave a fair product under light pressure, metal grinding by the use of solid emery wheels would not only be easier for the workman, but much more profitable. In attempting to introduce free cutting wheels, instead of the over-durable ones, one practical difficulty is frequently met. That is that the workman, habituated to excessive pressure, applies such pressure uselessly, to the softer and freer cutting wheel, and so wears it out with unnecessary rapidity and without adequate increase of product.

It is our firm belief that the general results of this investigation show the use of too many hard wheels, and the survival in grinding processes by solid emery wheels of the same old methods which characterized British practice by grindstones. The increasing use of waterproof wheels, run wet, also tends to the use of over hard wheels, and to careless work. The grinder thinks it easier to press his tool hard against a hard wheel, and trust to the use of water to prevent overheating, than to manipulate the tool with care against a free cutting wheel at high speed.—*T. Duncan Paret.*

OVERHEATED FURNACE CROWNS.

A LONG experience of human nature has given rise to the old saw, that "give a lie a start, and you must chase it round the world ere you catch it." In nothing is this more true than in the case of a false theory. One of the most persistent of these fallacies has been the theory that turning on the feed to a boiler, in which the furnace crown had been allowed to get red hot, would cause an instantaneous generation of such an enormous volume of steam that the safety valves would be unable to pass it, and an explosion would almost inevitably occur. This statement was made in almost the above words by Mr. Parkes, M. I. C. E., in the course of a discussion on boiler explosions in the Institution of Civil Engineers in the year of 1841, and has been repeated, more or less emphatically, by many engineers and others since that date. The theory had, it must be admitted, several advantages. When an explosion occurred, it was very comforting to the owner and builder to be able to attribute it to the carelessness of the unfortunate stoker, who was perhaps killed by the explosion, rather than to want of strength in the boiler arising either from bad construction or inefficient inspection, resulting in imperfect maintenance. Probably few theories have been more mischievous. Only a short time ago a firm of engine builders in the North were appealed to by a farmer to increase the valve load on a second-hand boiler from 45 lbs. to 80 lbs. per square inch. They examined the boiler and informed the owner that they did not consider it safe at its present load. In reply, the farmer, with the sublime self-confidence of a half-educated amateur, proceeded to inform them that "the latest scientific discoveries demonstrate that a boiler cannot burst if you keep it full of water." In spite of this, however, and apparently much to his surprise, he failed to convince the firm that the strength of a wrought-iron boiler shell was in any way affected by the quantity of water inside it. Even distinguished scientific men, like Professor Tyndall, have backed up this ancient superstition, modified, however, by supposing the water to assume a spheroidal state on reaching the hot plates.

The Manchester Steam Users' Association have always believed this theory to be unfounded on fact, and as long ago as 1867 made some experiments by injecting water into red-hot household boilers and found no explosion resulted. It was, however, thought that it would be well to repeat the experiments with an ordinary Lancashire boiler, and this the Association have done, and in the most public-spirited way are now publishing their results for the benefit of all steam users. The boiler chosen was of iron, 27 ft. 9 in. long and 7 ft. in diameter, with two furnace tubes 3 ft. in diameter, which were not strengthened against collapse in any way. The shell plates were $\frac{7}{16}$ in. thick, the end plates $\frac{9}{16}$ in., and the furnace tubes $\frac{7}{16}$ in. thick. The fire grates were 6 ft. long and 3 ft. wide. The boiler mountings were: Two feed valves $2\frac{1}{2}$ in in diameter, two glass water gauges, one blow out tap $2\frac{1}{2}$ in. in diameter, one 7 in. dial pressure gauge reading to 150 lbs. per square inch, fitted with a maximum index finger, and two safety valves, one of 3 in. and one of 4 in. in diameter. The feed inlets entered the boiler about 6 in. above the flues, and from them the water entered dispersion pipes 6 ft. 6 in. in length, which scattered the water directly on top of the flues. To protect observers, a stout barricade of 3 in. planks backed by earthwork was erected in front of the boiler, and a small hut, also of 3 in. planks, was erected 33 ft from the boiler; in this a supplementary water gauge and pressure gauge were fitted. The feed and blow-out pipes were also carried through the observatory, and the flow through them could be regulated by valves there. Cords connected to the safety valves allowed these to be eased without leaving the hut, and six index fingers, moving over graduated scales, and connected to rods passing through stuffing-boxes in the boiler shell down to the flues, showed any yielding of the furnace crowns.

In commencing the experiments a difficulty arose as to the proper moment for the injection of the feed. Owing to the danger, it was impossible to watch the furnace crowns till they got red hot, and it was therefore determined to make the first trial at atmospheric pressure. The safety valves were therefore propped open, and the water blown down to 16 in. below the level of the furnace crowns. The larger safety valve was then closed, but by an oversight the smaller was left open, and the feed turned on at the rate of $5\frac{1}{2}$ cubic feet per minute. The pressure of the steam rose in $1\frac{1}{4}$ minutes from 6 lbs. to 12 lbs., but at the end of one minute more it had fallen again to 1 lb. above the atmosphere. It was determined to repeat this experiment, closing both valves. The water was again blown down 16 in. below the level of the furnace crowns, during which time the fire was 7 in. thick and burning clear and bright, with the dampers full open. The feed was then turned on and the pressure rose to 27 lbs. per square in. in three-quarters of a minute, the safety valve being loaded to 50 lbs. After this it gradually fell, and in $13\frac{1}{2}$ minutes had been reduced again to 6 lbs.

These two experiments alone should be sufficient to kill the bogey which was raised so many years ago and has not yet been laid. It is hardly possible that the water should get as short in practice as it did in these experiments, or that such a large extent of surface should be overheated. Yet, instead of a sudden explosive generation of steam, which the safety valves should be unable to pass, the maximum pressure reached was only 27 lbs., or quite insufficient to make the safety valves blow off. It is true that the pressure in the boiler was very low at the time the water was turned on, but from the data given it is easy to find the weight of steam generated. Full particulars of the boiler are not to hand, but on scaling the sketches sent us it appears that at the time the water was turned on in the second experiment the steam space in the boiler was about 460 cubic feet. The pressure at the instant of turning on the water was 6 lbs. above the atmosphere, whence the weight of steam in the boiler at the time was about 24 lbs. In three-quarters of a minute the pressure was increased to 27 lbs., after which it fell. At this latter pressure there would be about $46\frac{1}{2}$ lbs. of steam in the boiler, so that under the most favorable conditions the overheated plates in two furnaces were only able to turn $22\frac{1}{2}$ lbs. of water into steam. In the same time the furnaces, under very ordinary conditions, in which 10 lbs. of coal are burnt per square foot of fire grate per hour, with an evaporation of 8 lbs. of water per pound of coal, would have turned no less than 36 lbs. of water into steam. As the safety valves are designed to pass, if necessary, all the steam the furnaces can make, it appears that they would not have the slightest difficulty in dealing with the evaporation due to overheated furnace plates.

Gaining confidence from the success of their first experiments, the officials of the Manchester Steam Users' Association next proceeded to experiment at higher pressures. The overheated furnace plates, which had been damaged in the experiments just described, were first removed, and after rolling them to bring them back to their proper shape, were replaced in the flue. The boiler was then tested up to 100 lbs. hydraulic pressure, which it stood satisfactorily, and the preparations for the new experiment were accordingly proceeded with. It was thought that the difficulty of knowing when to inject the feed water might be met by carefully watching the indicators in the observatory, which were connected with rods resting on the top of the flue. On the first signs of collapse thus ascertained the feed water was turned on. Nevertheless, the right-hand furnace completely collapsed, and the steam and water rushed out below the bars. At this moment the steam pressure was 50 lbs. per square inch, and the rush of steam and water was very violent.

The collapse of this flue was the only injury the boiler received, the shell being totally unaffected by the failure. A number of lead strips, which had been laid on top of the furnace tube, were melted through, and were afterwards found at the bottom of the boiler.

In all the preceding experiments the water level had been reduced by blowing out as much water as necessary through the blow-out cock, but in the succeeding experiments it was determined to reduce the level by stopping the feed and evaporating the water off. The results obtained fully confirmed the previous ones. The pressure in every case commenced to fall the moment the feed was turned on, and thus the bogey of instantaneous evaporation may be said to be finally laid to rest.

In order to insure that the plates actually attained a red heat, Mr. Lavington E. Fletcher, who kindly furnished us with advanced proofs of his report, which we shall shortly publish in full, had a number of feasible plugs prepared of special alloys, and sample plugs were tested by inserting them in flat plates, which were then heated to redness over an open fire. Several of these plugs were inserted in the furnace tubes in the case of the later experiments, and, by fusing, conclusively proved that the plates were really red hot. The broad lines on which Mr. Fletcher has designed his experiments, and the thorough way in which he has carried them out, do not permit of any doubt being cast on his results, the more especially as they are fully confirmed by theory, which shows that owing to the very low specific heat of iron it would be impossible for any large quantity of steam to be generated by overheated furnace plates under the ordinary condition of working. In many cases the flues were found in a very shaky condition at the end of the experiments. This, however, is a very minor matter, compared with the great risk of collapse and consequent injury to the attendant if it is attempted to draw the fires. The very act of drawing the fires increases the risk of collapse, as it momentarily increases the temperature of the furnace, and instances where unfortunate firemen have been scalded to death whilst in the very act of drawing their fires are given in the report

In concluding, we should add that Mr. Fletcher has also embodied in his report a number of observations on the hogging of the furnace flues whilst raising steam. The greatest amount of hogging in the experimental boiler was $\frac{1}{2}$ in.—*Engineering*.

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THE DEVELOPMENT OF THE MARINE ENGINE.

MR. A. E. SEATON, an eminent English marine engineer, is now in this country, and at a recent meeting of the British Iron and Steel Institute, held in Pittsburg, conjointly with the American iron and steel manufacturers, read a paper on the above topic, from which we give an abstract:

"The marine engineer, he said, has been dependent on the ironmaster, and on many occasions his progress had been barred by the inability of the ironmaster to overcome obstacles to success in manufacture. It was the introduction of the Siemens steel plates that had opened the great field to the engineer. This had more to with the progress subsequently made in boiler construction than the introduction of the material of superior strength, inasmuch as it made it possible to construct a boiler with the minimum number of plates at a less expense than one with a maximum number."

After following the revolution in boiler construction, the paper said that it was followed by a demand for higher speed than thirteen knots. This meant more indicated horse-power, more coal, larger boilers, and finer lines, or, in other words, less ability to carry the heavier weights entailed by the greater power. It was evident that such ships must depend almost entirely on passengers and light goods of high value. This high speed demanded has been given. In fifteen years speed has been increased from thirteen knots to twenty and more. The reasons of its accomplishment, briefly, were:

First.—Increase in working pressure from an average of 75 pounds to an average of 150 pounds per square inch.

Second.—The adoption of the triple and quadruple expansion system so as to utilize steam of this high pressure efficiently.

Third.—The adoption of artificial means for obtaining sufficient draught for the consumption of coal, and, when desired, for an increased consumption of coal, so as to give an augmented supply of steam without additional boiler capacity, with the result that in naval ships now, with practically the same weight of machinery, the indicated horsepower is nearly doubled, and in the mercantile marine the indicated horse power is 50 to 75 per cent. more for the same weight of machinery as was used fifteen years ago, the consumption of coal being 20 per cent. less than ten years ago, and 25 to 30 per cent. less than fifteen years ago.

Leaving the subject of more speed, Mr. Seaton said:

"If the owners or managers of ships in that trade had been well advised they would long ago have separated the passenger from the goods trade. A steamer for passenger service only could have been built for the speeds now attained at far less cost, in every sense of the word. It is only those who have to work out some of the problems set them by ship owners that appear to know and to appreciate the tremendous cost that is paid for the ability to carry the few hundreds of tons of cargo possessed by the Atlantic greyhounds."

Mr. Seaton traced in detail the improvements in marine machinery, due to the cheapening of best quality steel and bronze castings. On the important subject of propulsion, he says:

"The progress in propeller design and construction has been very slight, although each month seems to produce a new inventor with a new propeller—at least new to the inventor—that is going to revolutionize the shipping world; but in spite of newspaper paragraphs, full of hope and promise, if, alas! somewhat showing great want of scientific and technical knowledge of the first principles of propulsion, the screw propeller remains without a rival. Its shape has not altered much, although the very bad forms have gradually died out: and although much has been claimed by those having the pitch varying in all kinds of ways, the fact remains that in the navy, as in the mercantile marine, those who have given most thought to the subject and most observation, prefer a propeller of uniform pitch throughout—in other words, it is desired that its acting surface shall be a part of a true helix.

"Propulsion by twin screws has many practical advantages, but it is chiefly now adopted from considerations of safety, inasmuch as a ship with two screws is less liable to have both injured at the same time, and therefore her whole propelling apparatus broken down, than one with the single screw; and in case of accident to the steering gear she can be steered by varying the revolutions of the engines. Moreover, a smaller propeller is required for each of the twin screw engines than that needed for a single engine of the same power; hence, in the case of a deep-draught ship, owing to the deep immersion, the twin screws work with a higher efficiency, and in the case of a shallow-draught vessel the same holds good, inasmuch as they are thoroughly immersed when the single screw of the same power would be partly out of the water."

◆

MANY times when you are very indignant you are in the wrong yourself,

ABOUT SAFETY VALVES.

SAFETY valves are fitted to boilers in order to prevent the steam pressure under any circumstances exceeding the limit fixed by considerations of safety.

The only means whereby a boiler can be relieved from over-pressure of steam is an orifice in the boiler shell of sufficient area to allow the steam to escape as fast as it is generated.

A safety valve must be self-acting; that is, the orifice provided must remain closed to the moment when the steam pressure reaches the limit previously fixed.

After that it ought to open the orifice sufficiently wide to allow the superfluous steam to escape.

Finally, the safety valve must close it again before the pressure falls below the normal limit—namely, that pressure at which it opened.

No safety valve fulfills all these conditions perfectly; but in proportion as it does fulfill them, it approaches the ideal of a perfect safety valve.

Briefly, the three conditions are:

First.—To open at the right pressure.

Second.—To prevent any accumulation of pressure.

Third.—To close without permitting any loss of pressure.

It may be thought a simple matter to provide for each and all of these requirements, but if we look into the action of an ordinary safety valve we shall see the difficulty of the problem.

In the first place it is found that the *velocity* with which steam escapes through an orifice does not depend to any considerable extent upon the pressure either *inside* or *outside* the boiler.

The velocity of high-pressure steam escaping from a boiler into the atmosphere may be taken in round numbers, as 900 feet per second for all pressures from 60 lbs. to 150 lbs. per square inch.

But the *quantity* of steam thus escaping through an equal orifice will be much greater at the higher pressure than at the lower, on account of the density being so much greater.

Now the true measure of the *quantity* of steam at any pressure is the quantity of water which has been evaporated to produce it, or the quantity of water the steam will make when condensed.

Again, the quantity of water which a boiler can evaporate is very nearly the same at all pressures, being from 7 lbs. to 8 lbs. per pound of coal burnt.

Any difference in evaporative power being as much due to the quality of the fuel and condition of the boiler as to any difference in pressure and temperature.

Also with ordinary draught, the quantity of coal burnt is fixed by the area of fire grate surface, entirely independent of steam pressure.

It is thus possible to establish a relation between the area of safety valve necessary to allow the escape of the steam, and the area of the grate surface upon which the fuel is burnt.

A square foot of fire grate burns a certain quantity of coal, say 16 lbs. per hour, and at the above rate of evaporation this will evaporate from 112 to 128 lbs. of water per hour.

So far we are independent of pressure, but now let the pressure be 75 lbs. gross. At this pressure every cubic foot of steam will require .176 lb. of water to make it, hence a mean evaporation of 120 lbs. of water will make $(120 \div .176) = 680$ cubic feet of steam per hour, or about one-fifth of a cubic foot per second.

If the pressure is 150 lbs. gross, or just double the previous pressure, each cubic foot of steam will require .337 lb. of water to make it, and with the same evaporation as before only $(120 \div .337) = 356$ cubic feet of steam will be produced.

Now, since the velocity of escaping steam is not practically influenced by its pressure, we see that the safety valve for the higher pressure, in which only 356 cubic feet of steam is produced per hour, need not be much over half the area of the safety valve for the lower pressure in which 680 cubic feet are produced in the same time.

The Board of Trade rule prescribes just half the area at 150 lbs. gross pressure that it does at 75 lbs.

Let us now see what actual area of orifice should be necessary for the safety valve.

The volume of steam escaping through a square inch of orifice at the rate of 900 feet per second will amount to $(900 \times 12) = 10{,}800$ cubic inches or $6\frac{1}{4}$ cubic feet per second.

But we have already found that for steam at 75 lbs. gross pressure, only one-fifth of a cubic foot of steam can be made per second by each foot of fire grate.

It follows, therefore, that a very small area is really necessary per foot of fire grate for the steam, namely—$\frac{1}{5} \div 6\frac{1}{4} = \frac{1}{31}$ of a square inch.

This is the area of an *orifice*, or aperture through valve, when the valve is blowing off.

It would be a grave mistake to confuse the area of orifice with the area of the valve itself.

The latter is fixed by the Board of Trade, but the steam fixes the former for itself.—*A. N. Somerscales.*

◆

NEARLY all branches of the Government claim that they are more or less embarrassed for want of sufficient force. Occasionally a wail goes up of overwork and hard service by those "in office," as they term it. As a matter of fact, Government employees work fewer hours and get more pay than any other class in the Union. There are in Washington about twenty thousand persons connected with the business of the Government, embracing chiefs, or heads of divisions, chief, disbursing, and appointment clerks, chief examiners, stenographers, clerks of Classes Nos. 1, 2, 3 and 4, clerks of the thousand-dollar class, copyists, typewriters, copyholders, messengers, assistant messengers, watchmen, down to laborers and charwomen; with salaries ranging from $3,000 down to the lowest, about $420 per annum. The hours of labor in the departments are from 9 o'clock A. M. to 4 o'clock P. M., with half an hour intermission for luncheon, making only $6\frac{1}{2}$ hours for work. During three months in summer the departments close at 3 o'clock. In addition to this, each employee is given thirty days a year for vacation on full pay. Admitting that they work $6\frac{1}{2}$ hours per day, which is a very liberal estimate, then add to each of the 20,000 employees $1\frac{1}{2}$ hours, making 8 hours of service, and you have 30,000 hours additional work, or 3,750 days 144 months, or 12 years' work each day for one person. In other words, if the 20,000 employees worked 8 hours per day, instead of $6\frac{1}{2}$ hours, they would be equal to 23,750, or an increase of 3,750.

◆

ONE would think, says the *American Miller*, that the owner of the boiler would be the prime party interested, as in a majority of instances it is his property and life, equally with the lives of others, that are jeopardized. In Great Britain there is no question that the owner's caution has been one great cause of the decreasing liability to explosion. The Board of Trade Commissioners have uniformly endeavored to instruct the British boiler owner by holding him responsible. Here, however, the owner of a steam plant does not seem to feel that he is an interested party. One who is in authority in such matters lately informed the writer that he has been amazed at the attempt of owners to get licenses for persons clearly incompetent, seemingly regardless of their own vital interest in the matter. We are a great people; but we need to learn some lessons from other great peoples. This thing of boiler explosions is one of them.

Oh, yes; it is all true; we have been preaching this gospel for a great many years, and rejoice that others lift up their voices in accord.

TRADE NOTES.

THE Mason Regulator Company, Boston, Mass., have issued a very elegant blotter, with calendar for 1890 and 1891, which is handy to refer to. They also issued a new catalogue October 1, which contains a full description of their steam regulating devices and other goods. Send for it and keep it for reference.

⁂

THE engineering societies of the United States and Canada wil call an international congress of engineers in Chicago during the World's Fair. A committee has been appointed to notify the engineers' societies of France, Germany, and other countries of Europe of this action of the convention, and ask them to co-operate in the international congress.

⁂

THE Lake Erie Engineering Works, Buffalo, N. Y., Richard Hammond, president, and P. A. Kane, superintendent, has begun the erection of a foundry and machine shop to cost $300,000. The machine shop will be 250 by 112, and the foundry 230 by 112; both buildings will be of brick with slate roofs, and will be supplied with heavy machinery. They are to be ready for use about January 1.

⁂

THE '*Evolution*,' the yacht which was to be driven at a high speed—thirty miles an hour—has at last been tried, and so far has made a failure of it. Ten miles an hour was her best, though it is stated she did not use all her power. Even with this reservation she will not achieve anything like the speed assigned for her, and will be no doubt another instance of failure through men being wiser than their day and generation.

⁂

A SIGN of the progress which is being made in electricity is the rapidly increasing size of the dynamo units adopted at central lighting stations. At the Electrical Exhibition of 1881 the most powerful dynamo was an Edison machine, giving 800 amperes, and 110 volts (120 h.p.) The Berlin central stations now have 500 h.p. dynamos, and at Deptford a 3,000 h.p. alternator is at work, and two 10,000 h.p. machines are expected shortly to be in operation.

⁂

MESSRS. HARIG, KOOP & CO., Louisville, Ky., after experiencing more or less trouble from rust and scale in the mud-drums of the boilers, applied with great success graphited oil purchased from the Joseph Dixon Crucible Co., Jersey City. The mud-drums were cleaned out, and the graphited oil applied with swab, brush, or anything handy, to the joints and parts where the water enters the drum. Every four or six weeks this process is repeated with the most gratifying results.

⁂

CRITICISM is heard from engineering experts on the propeller designs of the big twenty-two-knot cruiser. This vessel is being built by the Cramps. '*The Pirate*,' as the vessel is known, will have three screws, placed one on each quarter and one in the position where single screws are ordinarily carried. The shaft of the twin screws diverge. The central shaft inclines slightly downward. The quarter screws are three-bladed, and have a diameter of 13 feet. The central screw is four-bladed, and has a diameter of 12 feet. The criticism is on the central screw. The opinion is advanced that it should have greater diameter.

⁂

HENRY R. WORTHINGTON says: "There being on the market many cheap imitations of Worthington Steam Pumps, we would call the attention of parties about to purchase pumping machinery to the fact that pumps of our manufacture are conspicuously marked with our trade name, the use of which by any other manufacturer is unauthorized and illegal. Messrs. James Simpson & Company, Limited, of London, England, and their licensees, have the exclusive right to manufacture abroad Worthington Pumping Engines of the compound condensing types."

⁂

DR. EMMENS, of Greensburg, Pa., is said to be the discoverer of a process of making wrought-iron from pig metal without puddling. A vat is filled with a chemical solution and a number of thin sheet-iron plates. The pig-iron is also placed in the vat, and the two metals are connected to a dynamo. The current, which is then passed through the vat, is said to have the effect of causing the pure iron to be separated from the impurities in the pig-iron, and to form a deposit on the sheet-iron plates. It is claimed that the wrought-iron produced can be bent, rolled or twisted into any shape while cold, and is superior to the best Swedish metal.

⁂

SOME Peekskill gentlemen have determined to establish a Naval Navigation Training School for the purpose of instructing young men who desire to fill positions in the United States Navy and merchant marine. They have formed a stock company, with a capital of $35,000, the shares being of $1 each. The School will be known as the Hudson River Naval Navigation Training School. The vessel to be used by the school will be a full-rigged ship of about 270 feet in length, 30 feet beam, 21 feet depth of hold, and a displacement of about 2,600 tons. It will have room for 100 cadets, and it will be conducted on the same principle as any college or academy. Students will be continually on board ship under supervision of a competent corps of instructors. It is hoped to be able to have everything in readiness on April 1 next.

⁂

THE Navy Department has completed details of the plans for a twin-screw, armor-plated harbor-defense ram, upon the plans of Rear Admiral Ammen, retired. The vessel is cigar-shaped, and but for her armored tower, smoke pipe, and ventilators, would have the appearance of a whale lying upon the water. Her principal dimensions are: Length over all, 243 feet; breadth on water line, 41 feet 10 inches; draught amidships, 15 feet; displacement, 2,050 tons; indicated horse-power, 4,800; speed, 17 knots. The engines are triple expansion, of the horizontal type, each in a separate compartment. There are four cylindrical horizontal fire-tube boilers placed in two water-tight compartments. The vessel is to be submerged to fighting trim by means of fourteen Kingston valves, one in each transverse water-tight compartment of the double bottom, and sluice valves will be filled in the vertical keel, and the water-tight longitudinals in these compartments. The only projections above the armor deck are the conning tower, smoke-pipe, ventilators, hatch coamings, and skid beams upon which the boats are supported. The vessel has no armament, and is to rely entirely upon the ram for her offensive powers.

⁂

EDWARD WEST, at Lexington, Ky., in 1797, invented and put in operation a steamboat some six years before Fulton. The *Western Spy and Hamilton Gazette*, August 11, 1801, gives an account of this pioneer steamboat. It says that West, who was the father of the famous painter, came to Lexington from Virginia in 1785. He was an educated watchmaker and spent all his time in working on steam machines. It tells of the trial trip of West's new boat on Elkhorn Creek, at Lexington, in 1793. A patent was obtained, but the boat was not heard of again until 1801, when it was brought to Cincinnati. The Lexington *Gazette* of April 20, 1816, said:

"A steamboat owned by a company of gentlemen of this town (Lexington) was to sail yesterday to New Orleans from near the mouth of Hickman Creek. We are informed that she is worked on a plan invented by Mr. West, of this place, nearly twenty years ago, and in a manner distinct from any other steamboat now in use. On trial against the currents of Kentucky, when that river was very high, she more than answered the sanguine expectations of her owners, and left no doubt in their minds that she could stem the current of the Mississippi with rapidity and ease. West's models were destroyed when the British seized Washington."

◆

THE Navy Department is preparing plans for a torpedo cruiser, bids for which will be invited. This cruiser is to have a displacement of 750 tons, and engines of 6,500 h.p. The speed required will be about 23 knots. The plans have not yet been completed. The torpedo boat is to be slightly larger than the '*Cushing*,' and, if possible, an improvement on that craft. The plans must come from the bidders, only the general dimensions being furnished by the department. The displacement is to be 115 tons, the length 150 feet, and width 15 feet. A speed of 24 knots is required, and it is expected that 27 knots will be secured with the engines of 6,500 h.p.

◆

AN example of blind mimicry, such as we suppose the Chinese alone are given to, is seen in the little tool which fish dealers use for scaling fish. The man who invented this scraper, a few years ago, made it out of a curry comb, attaching one smooth blade to the handle in place of the toothed blades which had formed the comb. Other fish dealers saw him using his invention, and borrowed it to have some made like it. These were made with the useless blades of the curry comb. Now the article is a staple, and thousands are turned out, but the relics of the comb are reproduced in every one.

◆

THE stockholders in the Eiffel tower enterprise are feeling blue just now in consequence of the steady diminution of their receipts. In the season now closing 665,000 francs were taken in. The cost of keeping the tower open was 350,000 francs, and 300,000 francs more were spent for repairs. Next season the small profit of this year will be wiped out, it is expected, and a considerable deficit will appear in place of it. In view of this probability 168,000 francs were reserved for future use from the profits of the Exhibition year.

THE Alaskan canoe is hewn from a single log, on long, slender lines, and rises at the bow with a high, sharp point. They are painted with a mixture of soot and seal oil, but they are damp and unpleasant boats to ride in. An Adirondack canoe is a canal boat for steadiness as compared to these teetering canoes that balance on hair lines and fairly toss unwary passengers into the water. There are no cross pieces or seats, and the Indians sit flat on the bottom of the canoe and maintain one position for hours without moving; on journeys they are very dictatorial to white passengers, because of their restlessness and incessant changes of position, which threaten to capsize the canoe each time.

◆

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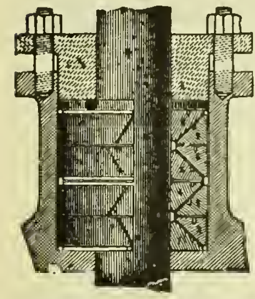

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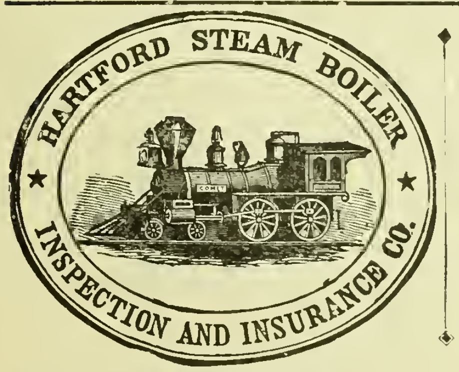

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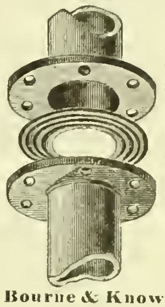

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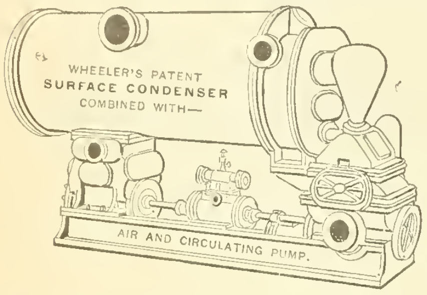
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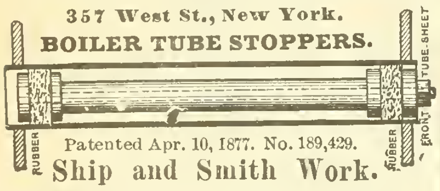

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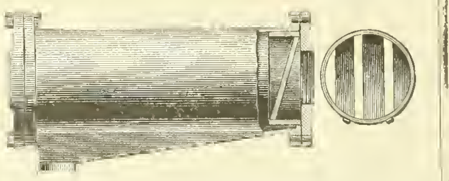

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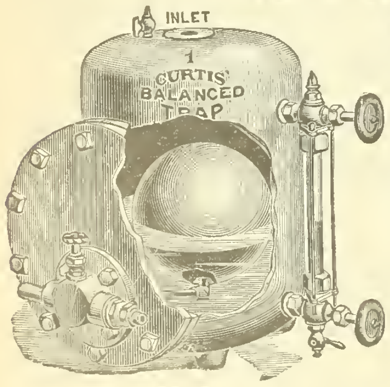

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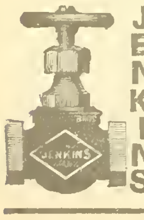

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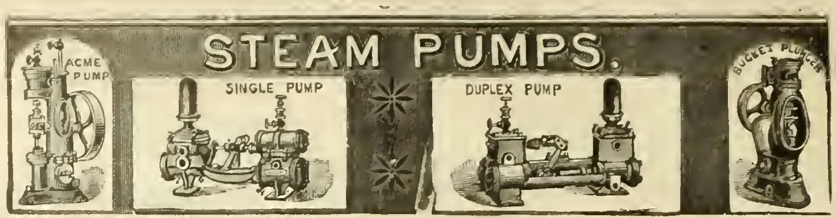

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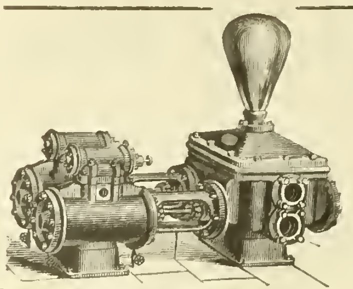

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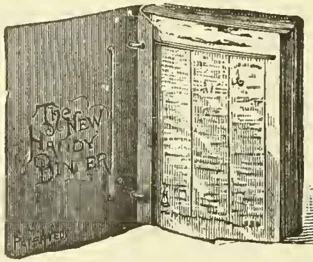

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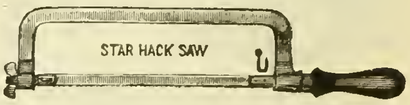

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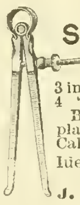

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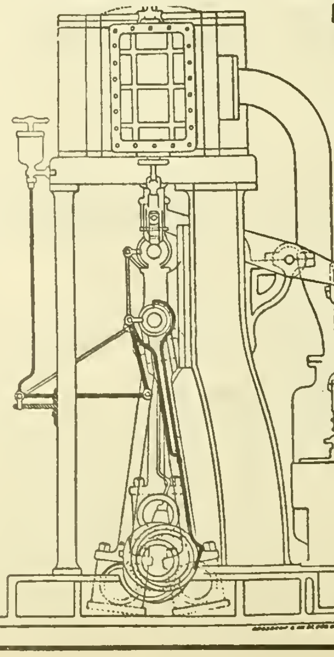

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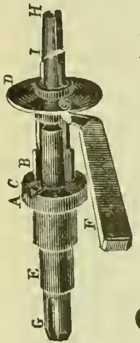

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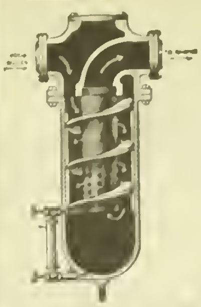

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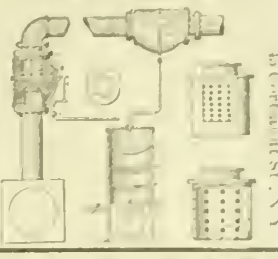

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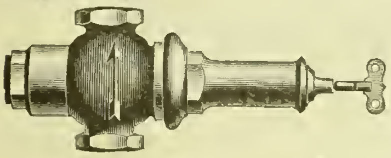

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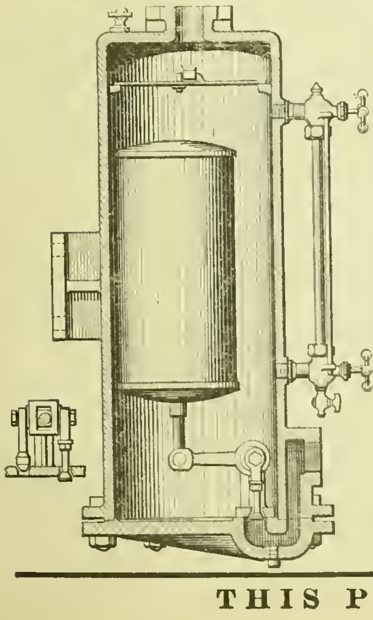

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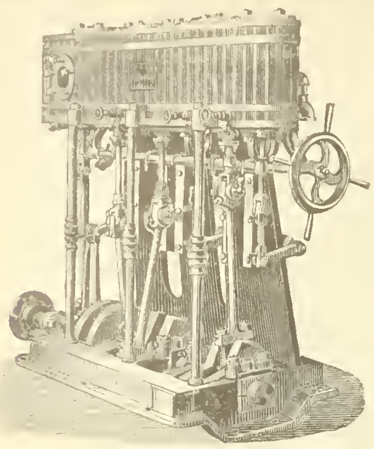

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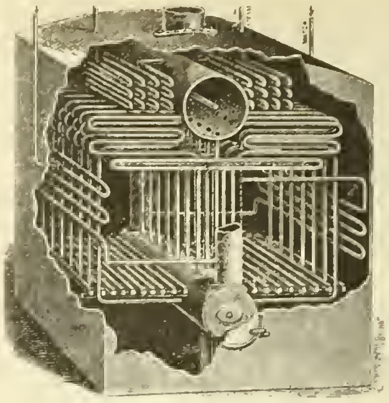

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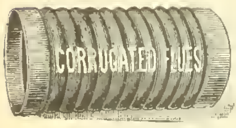

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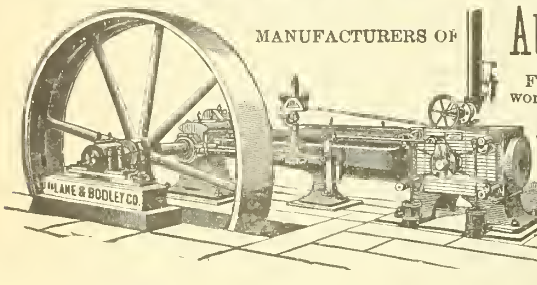
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It does not infringe on the patents of any valve made.
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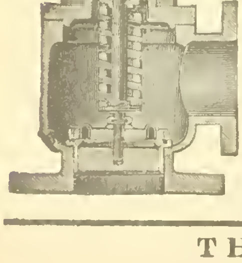

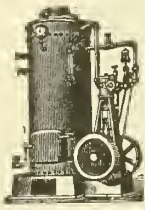

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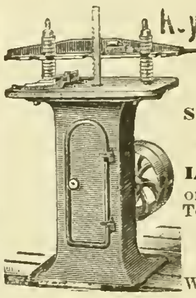

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A SPECIALTY.
SEND FOR LIST OF
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WORKS AT NEWPORT NEWS, VA.,
(ON HAMPTON ROADS.)
Equipped with a Simpson's Basin Dry Dock, capable of docking a vessel 600 feet long, drawing 25 feet of water, at any stage of the tide.
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Tensile strength upwards of 79,000 lbs per sq. in. Torsional Strength equal to the best Machinery Steel. Anti Frictional and Non-Corrosive. Can be Forged Hot.
Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, etc. Spring wire.
ANSONIA BRASS & COPPER CO.,
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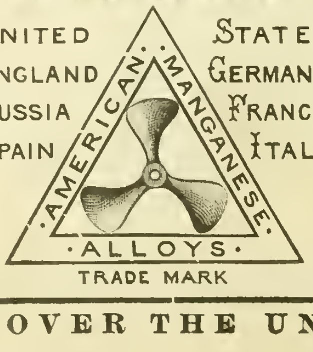

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B. H. CRAMP & CO.,
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SOLE MANUFACTURERS OF
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MANGANESE BRONZE PROPELLER WHEELS
—A Specialty.—
TO OWNERS OF STEAM YACHTS.
We particularly call your attention to advantages derived from the use of these Wheels for Steam Yachts, and would recommend as a means of obtaining "maximum speed at minimum expense" that you adopt a Manganese Wheel.
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THE ENGINEER.

NEW YORK

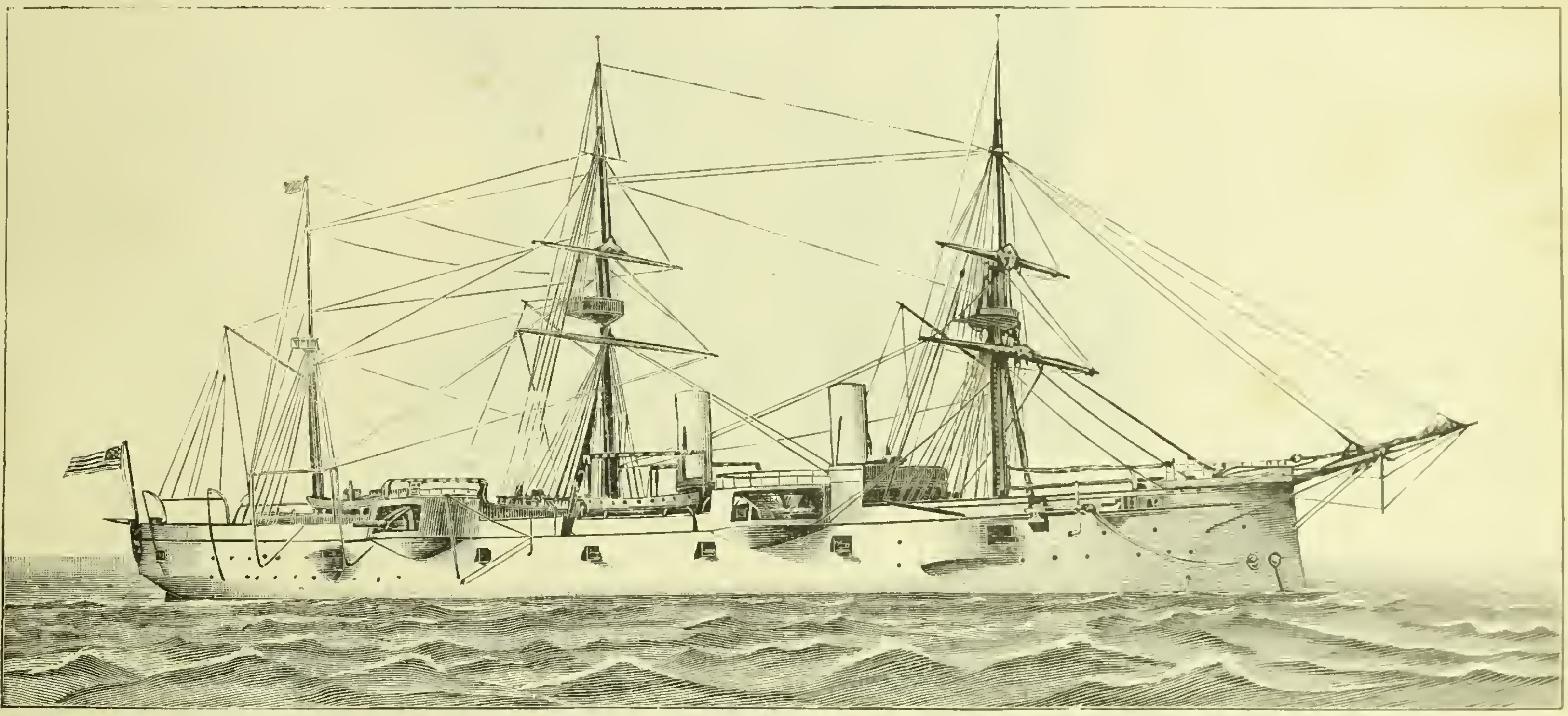
NEW SERIES. 1883, 1888. **Vol. XX. No. 10.**
TENTH YEAR OF PUBLICATION.
STEAM ENGINEERING, APPLIED MECHANICS, AND THE ALLIED ARTS.

November 8, 1890.
$2.00 PER ANNUM. - SINGLE COPIES, 8 CENTS

THE NEW NAVY. No. 1.

THE CRUISER 'CHICAGO,' U. S. N.

WE shall in forthcoming issues present engravings of the new naval vessels as fast as they can be procured, and present as the first one of the series, the '*Chicago*,' the flagship of the squadron of revolution so-called, recently returned from foreign cruising. The '*Chicago*' is an armed steel cruiser, 342′ 4″ long, 48′ beam, and 34′ 10″ deep from top of spar deck beams to base line. Her mean draught is 19′ 1″, and her displacement 4,536 tons; her plain sail area is 14.880 square feet. The engines are of the beam variety, and are of 5,000 h. p., driving twin screws having four fixed blades each, right and left handed, 15′ 6″ diam. by 24′ 6″ mean pitch. The engines are compound condensing, with cylinders 45″ diam. in the h.p., and 78″ in the l.p., with 57″ piston stroke; the valves are slides driven by the usual link motion, with cut-off valves on both cylinders. Both sets of engines are enclosed in water-tight compartments, and are so arranged that they can be worked high pressure (non condensing) in the case of the condensing machinery being disabled. The boilers are peculiar in their setting; there are 7 of them of the usual return tubular type, but instead of internal corrugated furnaces they have external fire-brick furnaces, very similar in arrangement to land boilers. Forced draught is provided on the air-tight, fire-room system, and the whole plan is found to work well. In cruising in all weathers, in six months' time, not a word has been uttered in public to the disparagement of brick furnaces for marine use, and we are forced to pronounce them a success. The steam system of the '*Chicago*' was devised as a type, and as a whole, by an American civilian engineer, Miers Coryell, of New York, and although not intended as a fast cruiser of the modern "high-flyer" type, the '*Chicago*' is able to make better sea speed, with greater coal endurance, than other naval vessels of her dimensions. The armament of the '*Chicago*' is adapted to her requirements, and she is able to give a good account of trespassers on American commerce.



◆

THE ENGINEER, of New York, tries to censure the *Marine Review* in a unique way for reproducing a cut of the torpedo boat '*Cushing*,' that was published in *St. Nicholas*, THE ENGINEER, and other publications, and in the same issue prints, without credit, a cut of the inclined engines of the English boat '*Mana*,' which should be considered the exclusive property of the *Steamship*, of Scotland.—*Marine Review.*

We invite our friends to state the facts correctly. We made a wood cut of the '*Cushing*' from a photograph, not from the *St. Nicholas*, and our contemporary made a photo cut from ours without credit. It is a small matter any way. The inclined engines shown in this paper were not the property of *The Steamship*, but were published in two other foreign papers previously. THE ENGINEER always credits when it copies. Lesser papers steal.

◆

TAKE a quart of water and dissolve in it a teaspoonful of pure powdered alum. Stir into this enough flour to make a thick cream. Break up every lump of flour until the mixture is smooth. Stir in next a teaspoonful of powdered resin. Now pour in a cupful of boiling water. Stir well. A few drops of oil of cloves will prevent souring. When the mixture has thickened from cooking by the boiling water, pour into an earthen vessel, not a tin can, cover it up and keep it in a cool place. Whenever you want to use any portion of it, take what you need and soften it with a little warm water.

◆

THE body may grow old, the mind never. It is young and fresh, and vigorous, even when the body is weakened by disease.

THE '*Baltimore*,' U. S. N., recently averaged seven knots an hour, not much more than half the speed of a quick-heeled sailing craft with a fair wind, on a voyage to Stockholm, Sweden: and, while one apologist may allege that she had orders to go "slow," and another that this snail-like pace was owing to foul bottom and lack of sheathing, it may be averred without the fear of contradiction that she has not done anything since her trial trip to indicate a capability to fulfill her mission in time of war.—*Scientific American.*

This is not fair. What does our friend want the '*Baltimore*' to do to demonstrate her ability. Carry passengers on the Fall River route? The new navy of the United States consists of able vessels, and on the cruise of the White Squadron the highest praise was given the ships composing it by foreign builders.

◆

IT is curious that the more physicians write about the complexion, and the more conclusively they show that it depends entirely upon health, cleanliness, a simple diet, and outdoor exercise, the greater the army of quacks becomes. It would seem that any one ought to know that the color of the skin is due to the condition of the blood, and that the character of the blood cannot be changed by face washes. But these are apparently things that the world does not care to find out, and the public go on dumping fortunes into the hands of the specialist with more and more eagerness every year.

◆

To test the resistance of paper to varied mechanical wear, it is crumpled and kneaded between the hands. After such treatment a weak paper will be full of holes, strong paper will assume a leathery texture. The test also gives a rough insight into the composition of a paper, much dust showing the presence of earthy impurities, while breaking up shows overbleaching.

THE "AUSTRALIAN" GIFT SYSTEM.

A WRITER in the *American Machinist* happily satirizes the gift subscription business in the following quotation:

"In years gone it was customary in my shop to make presents to men about to leave, or about to be married, to men about to grow old, or about most anything. Those usually singled out to receive the presents were of the kind having a long line of honorable dont's—don't drink, don't chew, etc.

"The routine of these presentations was about like this: Some one that wished to be brought into prominence would suddenly discover a rare combination of qualities in a shopmate, and would straightway draw up a subscription paper:

"'We, the undersigned, earnestly wishing to fitly show our hearty appreciation of your many and genial good qualities in the performance of your various duties,' and so on, *ad nauseum*.

"Himsefo Ponderoso was an adept at drawup and out these papers, especially in drawing them out. The paper would be circulated in working hours, at a loss to me of more than the cost of the gift. At last I told Ponderoso that, if he would give me timely notice, I would pay for the next gift, and let him have all the honor.

"Then I formed the insurance gift association, which has been a success. Members pay in ten cents a week. When any unusual thing is going to happen to a member, due notice is given, and a present is made—for going away, $20.00; for coming back, $1.00; being married, $40 00

"Those that do not wish to be in the insurance association can give on the Australian ballot system. Each one, on going out of the shop, takes an envelope from a box, puts in it the amount to be contributed, and, on returning, drops it back into the box. The Australian system has developed some interesting facts. On being opened, many of the envelopes contain nothing. This is not so pleasant to Ponderoso, because his commission in buying the gift is considerably reduced.

"There is a trite saying to the effect that it is better to give than to receive, which must have been started by one that never saw a subscription paper. Many of us have had quite enough of the better, and would now be content with some of the other kind. After having both sides of the experience, we can the more easily judge of either; the very change will give zest to the better side. There are times when one would like to make a present. Some delicate attention has been shown, some kindly help given—so delicate and so kindly that to offer to pay is not in good taste, but this should not be a reason for asking others to contribute. We may also be benefitted by persons when even the offer of a gift is an intrusion. There may be cases in which every one that signs a paper does so from choice, but in very many the signing is done, in part, to avoid misunderstandings with shopmates. If drawn up by a foreman, a workman feels as if in some way his standing in the shop depends upon the amount of his contribution The Australian gift system does away with all undue influence and polite extortion, and lets one act freely one's own choice"

◆

LARGE numbers of iron mills in Pittsburg have abandoned natural gas and gone back to coal. The gas people made the price so high that it was no longer profitable to use it.

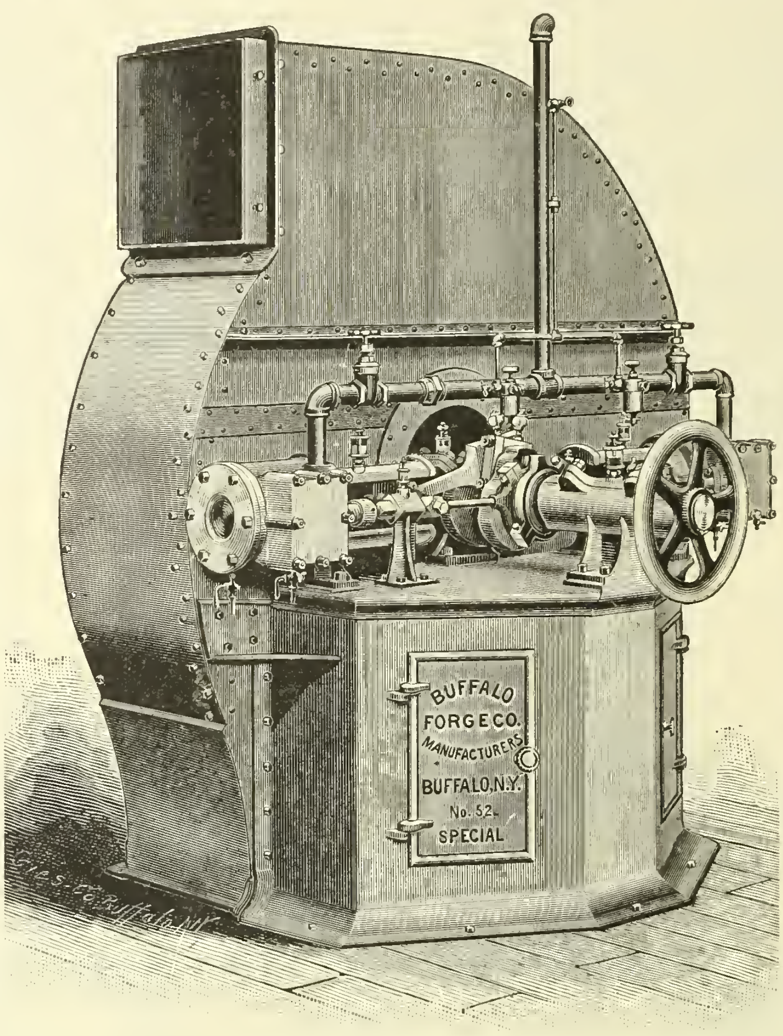
◆

WE think any young man, with a little outlay of time after hours, can secure a good list of subscribers for THE ENGINEER. Send for our circular.

THE BUFFALO MARINE FAN.

THE Buffalo Marine Fan illustrated herewith was designed especially for the West India fruiting steamer '*Neptuno*,' and is located in the engine room, arranged to exhaust the foul air from the ship's hold, where thousands of bunches of bananas and other fruits are stored. It has been found that cargoes of fruit thus treated arrived in a wonderfully good condition, the loss from decay being very slight, and far less than with the ordinary manner of handling during transportation.

Fans for marine use are not uncommon, but it is seldom that they are properly constructed. In the above instance, as in most cases of ship ventilation, it was desired to secure a certain amount of air at quite a pressure when running the fan at a minimum speed; hence it was necessary to build out of regular proportions for ordinary work. Its peculiar construction results in obtaining $2\frac{1}{2}$ oz. pressure at discharge, and in keeping up a circulation of air in every corner of the ship.


BUFFALO
FORGE CO.
MANUFACTURERS
BUFFALO, N.Y.
No. 52.
SPECIAL

Aside from being utilized as a ventilator, the fan is arranged so as to serve a double purpose, that of a blower for the furnaces, the air being forced through the stokehold to the fires.

The fan replaces the air in the ship every minute and a half, and is operated by a double direct-acting horizontal engine of 12 horse-power. Each engine has ample capacity to drive the fan independently.

On account of the position these engines are used in, there being continual motion of the ship, the greatest care and watchful attention to every detail entering into their construction is employed. The makers are the Buffalo Forge Co., Buffalo, N. Y.

◆

THAT the electric light is a powerful element of health is shown by the fact that those who use it feel better for its introduction, their appetite increases, their sleep improves, and visits of the doctor are reduced in frequency. Work people work all the better, and absences from illness are far less frequent. In a saving bank in London where 1,200 persons were employed, the absences from illness were so reduced that the extra labor gained paid for the electric light.—*W. H. Preece.*

OTHER PEOPLES, OTHER CUSTOMS.

ANIMADVERTING upon the trade methods as affecting popular tastes and the reverse, the London *Engineer* says, in a review of a work on the subject :

"The portions of the volume which possess the most general interest are those which refer to the wages, hours of work, and method of living of the French artisan, and the reasons why French coachbuilders have beaten English coachbuilders out of foreign markets. On this latter point we have certain facts given, which deserve the most serious attention of sensible men. It is too often assumed that the fanatics who preach technical education do no harm. This is, we have long suspected, a complete mistake, and this little work removes all doubt on the subject. The artisans who examined, not only the French carriages exhibited, but visited the workshops and studied French methods, hold that in no respect are French vehicles of any kind better than English. Technical education has done nothing, produced nothing in France, better than the English houses turn out. On one point, artistic finish, it might be supposed that they would excel home productions, but this is not so; and the reason why the dainty linings and choice materials employed by the French coachbuilders are not to be found in English pleasure carriages is simply that such things are unsaleable. English purchasers will not have them. They demand a repose and quietude of style which French workmen and artists regard as somber and gloomy. If the demand for something more lively, more novel, existed, Long Acre, Liverpool, or Newcastle-on-Tyne would quickly supply it."

This reminds us of the saying of a landlord in the country who ran his house to suit himself. Vegetables were scarce, and the guests demanded tomatoes.

"Tomatoes!" said the astounded landlord, "why, I wouldn't eat one!"

"Such things are unsaleable," says our contemporary, referring to carriages of a gay and festive appearance, meaning that they are unsaleable in England; but suppose other people demand something more cheerful than hearses to go about their business in, will not English carriage makers provide them? We think not, because John Bull is of the opinion on trade matters that Pall Mall governs all, and if other people are not suited with what he makes they can go without.

◆

CONSUMERS will do very well to watch dealers who are advancing prices on the claim that this is made necessary by the new tariff law. A number of instances of fraudulent increase have been called to public attention here. These are a few cases:

A purchaser of sheet lead was charged $2\frac{1}{4}$ cents a pound above the old figures, and, on inquiring the reason, was told that the McKinley bill was responsible for it. On reference to the bill however, it was found that the duty instead of being increased had been lowered from 3 cents to $2\frac{1}{4}$ cents a pound. The new law will be made a pretext for raising the prices of everything, and buyers should be on the alert. The duty on camphor, for instance, has been reduced from 5 cents to 4 cents a pound, on chloroform from 50 to 25, on carbonate of magnesia from 5 cents to 4, on white lead from 6 cents to 3, on cut nails from 14 to 1 cent, and wrought iron nails from 4 to 2 cents a pound, on gunpowder from 6 to 5 cents, on glass beads from 50 per cent. to 10 per cent. ad valorem, on strychnine from 50 cents to 40 cents per ounce, and so on through a long list of articles, the prices of which retailers are said to have increased, on the false assumption that the duty on them has been increased.

◆

Do not monkey with the American flag. Henceforth any person who shall use the national flag, either by printing, painting or affixing on it any advertisement, for public display or private gain, will be held to be guilty of a misdemeanor, for which the United States may mulct him $50, or send him to jail for a period of thirty days. So reads in effect the new law.

FLYING MACHINES.

It has been pointed out that there are no flying birds much over 30 lbs. in weight, and, reasoning from analogy, it has been argued that man cannot hope to improve upon nature in this direction; but not only are birds much more complicated in structure than a flying machine needs to be, having many functions to perform, wing-folding, feeding, reproduction, etc, besides that of mere flight, but they evidently expend much more energy in starting than in any other portion of their evolutions.

The smaller ones jump from the ground into the air with all their might, and then beat their wings with much greater rapidity and amplitude than in normal flight. If rising vertically, they soon exhibit signs of distress. Large birds in starting from the ground are compelled to run considerable distances, always against the wind, in order to gather headway and supporting power, and even with the most energetic flapping cannot rise at a steeper angle than 45°. All birds prefer to start from a perch, for by directing their first course downward they gather velocity from the action of gravity; at times some of the larger ones obtain relative velocity by simply spreading their wings wide to the breeze while yet on the perch, the object in every case being to avoid the great exertion required to obtain speed, for once fairly under way they are masters of their movements.

Resort to some equivalent devices will evidently be open to flying machines, but it is evident that until the question of stability has been thoroughly worked out, such experiments will be exceedingly dangerous; no such apparatus has yet succeeded in raising itself from the ground with the whole of its motive power, and the most that can be said at present is that recent elucidations of the laws of flight seem to indicate that it is not impossible for man to succeed with an aeroplane.

There are probably scores of shapes which can be made available for such machines, just as there are hundreds of forms of birds who display various peculiarities in their flight; but in every case there will be the same requirements as to a light motor, absolute automatic stability, and some device for gaining initial velocity, as well as for landing safely. This will require much experimenting, and a beginning has scarcely been made, so that even granting the accomplishment possible, the working out of the problem may prove to be slow.—*O. Chanute.*

◆

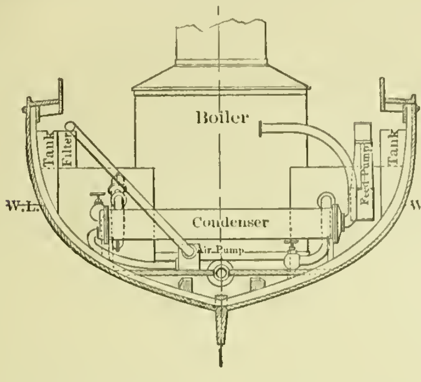
A gigantic pendulum has been suspended from the center of the second platform of the Eiffel Tower. It consists of a bronze wire 380 feet long, with a steel globe weighing about 198 pounds at the end. Its object is xhibit the rotation of the earth by the Foucault method.

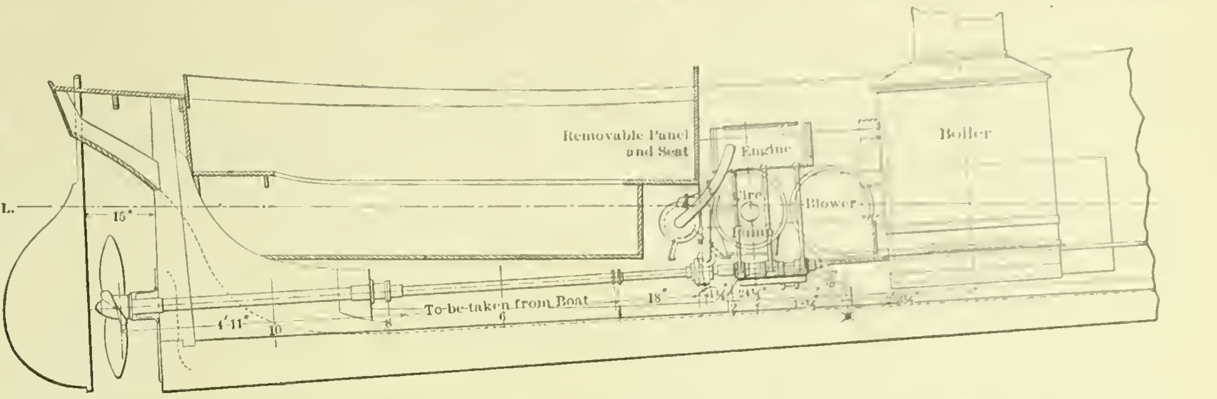
A great many persons have sent for our circular to canvassers, and we would like to have many more send for it. Any young man in a large town can make $25 before Christmas by a little skirmishing. The Engineer is read by all classes in the community, not engineers alone by any means.

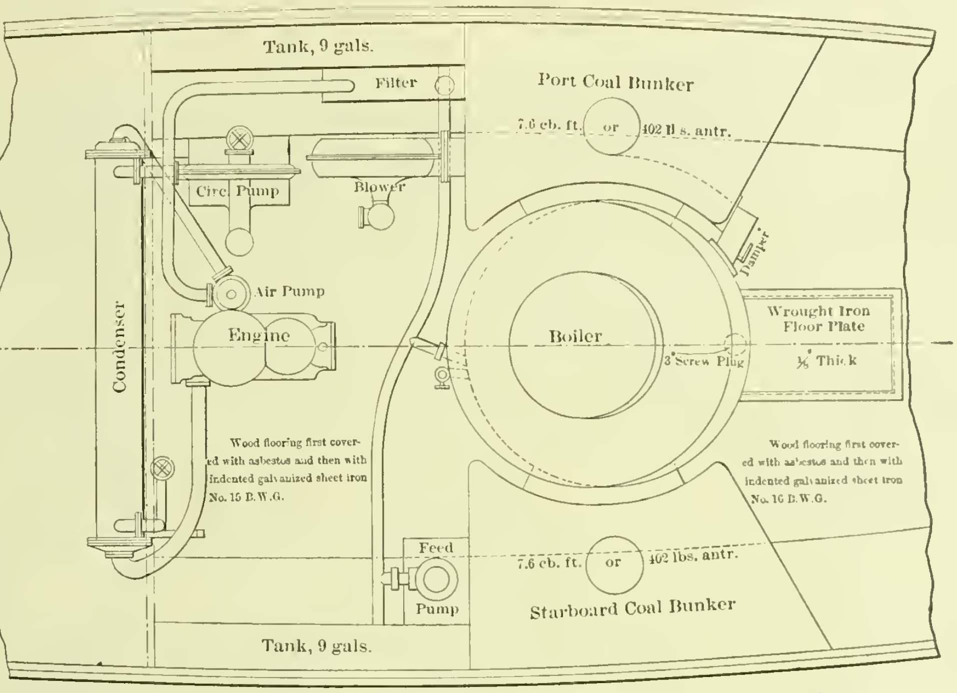
◆

THIRTY-FOOT STEAM LAUNCH.

The engravings represent the general arrangement of machinery, etc., in a thirty-foot steam launch, and are intended as guides for the steam machinery already shown in this paper. The plans are by the Bureau of Steam Engineering, U. S. N.



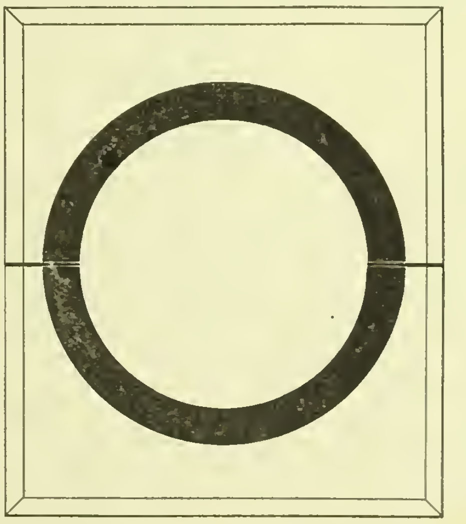



Tank, 9 gals.
Filter
Port Coal Bunker
7.6 cb. ft. or 402 lbs. antr.
Circ. Pump
Blower
Damper
Air Pump
Condenser
Engine
Boiler
3" Screw Plug
Wrought Iron Floor Plate
⅛" Thick
Wood flooring first covered with asbestos and then with indented galvanized sheet iron No. 16 B.W.G.
Wood flooring first covered with asbestos and then with indented galvanized sheet iron No. 16 B.W.G.
Feed Pump
7.6 cb. ft. or 402 lbs. antr.
Starboard Coal Bunker
Tank, 9 gals.

◆

LEATHER BUSHES FOR BEARINGS.

Mr. Elihu Spencer, an ingenious mechanic, of Elizabeth, N. J., recently showed us a pair of leather bushes for the crank-pin of a small engine which had been run for a long time with no signs of wear. The leather was prepared by soaking or boiling it in linseed oil, which seems to have completely altered its nature and texture by some process of chemical transformation, so that it is like horn, very tough and durable. Mr. Spencer says he has used leather for this purpose many times, and has been surprised at its endurance and reliability. Of course it is not suitable for a bearing which is rough. In some emergencies, knowledge that leather bushes can be used upon bearings is of value. We have no doubt but that it would prove useful in loose pulleys if properly put in.



◆

A great reason why the engineering profession is still so ignorant of facts and data in its own science is that these facts and data are not easily obtainable in any shape which renders them valuable for comparison and permanent record. An isolated fact, such as that a certain steam engine requires 20 lbs. of steam per hour to develop 1 horse-power, is of no value for scientific purposes, unless it is known precisely under what conditions that result was obtained, including type, dimensions, speed, cut-off, clearance, back pressure, jacketing, quality of steam, etc., and even if these are all known, the result contributes but little to our knowledge, unless it can be determined how the result of 20 lbs. will be varied by a change in each one of the numerous conditions. To obtain such a record, and to make any generalization from it, requires an exceedingly tedious and expensive investigation by a trained expert. A few years ago an experimental compound engine, costing some thousands of pounds sterling, was presented to Owens College, in Manchester, and experiments for nearly a year, undertaken by Professor Osborne Reynolds, with an ample corps of assistants, have given thus far very few figures of permanent value in increasing our knowledge of compound engines and the laws of their action. They, in fact, have thus far only served to reveal the fact how dense is our ignorance yet concerning these laws. The immediate need of the profession in this matter is not more schools, more books, more society papers, but more experiment.—*American Machinist.*

◆

An experimenter abroad who has been trying to make a flying machine, says:

> "I have abandoned my attempts to procure a light and energetic motor in favor of man's weight, for, as a constant motor, maintainable with least consumption of fuel, it is unsurpassable; and since no engine power has obtained equally valuable results, it appears to me quite clear that human power judiciously applied will prove as effective for man's transition upon air, and with equal speed and certainty, as bird power proves for birds. So that an aerotransitor, manned by an energetic crew, exerting their weight and muscular power on adequate sustaining surface, could in ordinary weather successfully and speedily accomplish lengthy journeys to great advantage, and far more satisfactorily than wasting their substance upon monstrous balloon surface, which would consume at least eleven times the power per pound as a rook consumes for sustaining and propelling one pound weight at equal velocity. One source of difficulties to overcome is the getting of reliable working parts of adequate strength. My recent trial proved improvements to approach very nearly practical success when stopped by the breaking of right-hand brass pinion; for, like the primitive steam engines, adequate strength in the working parts is the last mastered."

"Very nearly flying" seems to us synonomous with not flying at all.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

A WORD WITH A YOUNG FRIEND.

Editors Engineer:

Seeing the interest you take in young engineers, giving them good advice through your paper, I venture to ask for a little myself. I am a subscriber to THE ENGINEER through a news agent; and if I don't get it on time (which is not very often) I am very much disappointed. There are several engineers that I know who subscribe to your paper, and also other papers of the same kind, but the opinion of them all (along with myself, is THE ENGINEER is the best one published in the interests of engineers. I am an engineer of a small steam launch, (non-condensing); also I have a small non-condensing license to run the same. Now, I would like to know how I am to get a higher grade license. I was told by an inspector that I should have to get practical experience before I could run a condensing engine. If that is the case I am afraid I shall never get one, as I cannot go on a steamer with a non-condensing license. Probably you could advise me what steps to take; as I have not had much experience in marine engineering, and would very much like the advice of those who have had the experience, for I am sure there is nobody more desirous than myself to receive the advice of others.

Is there any good book on condensing engines that you would recommend? I am afraid, Mr. Editors, that you will get tired of the book question. You may think that I am one of those individuals who think editors have nothing else to do but to answer questions. I have already trespassed too much on your space. With success to THE ENGINEER.

Cornwall Landing, N. Y. INQUISITIVE.

[The steamboat inspection laws say that an applicant for a license must have had one year's experience in the engine-room of a steamer or in a machine shop building steam engines. The law takes no cognizance of condensing or non-condensing engines, as regards the application, but we fear that in the strict interpretation of it the inspectors would not recognize a steam launch as "a steamer," as it is, of course, in fact. The only way then to get on as an engineer is to try for a situation as oiler on a river boat; a tug would answer all the requirements of the law as to the experience of one year on a steamer.

Possibly, our correspondent says, the trouble is to get the job as oiler. No doubt it is; there is always difficulty in getting a start, but if the starter is determined to get it he gets it, in the same way his predecessors did—by keeping on trying. That is the whole secret of success in this world—keep right on. Stick! Never let go. If the ship goes down, go with it; you will come up if you deserve to come up. This is the experience of all who have ever achieved any success in life. Let our young friend make interest, and commend himself in all ways he can think of to those who can put him in the way of his desires, and if they see he is in earnest, and a worthy young man, sooner or later he will achieve what he seeks.

As to books—well, that is a question of capacities. There are men who can learn from books at sight, so to speak, by simply reading them; and there are others who need a preparatory course in common schools to fit them to study. It is of infinitely more importance to a young man that he should have a good common school education first, as a foundation, than that he should have a smattering of philosophy. A knowledge of the first four rules of arithmetic (and as many more as may be wished), and how to read and write the English language (not as a scholar) reasonably well, is solid acquirement, which lasts a man all his life; without it there is little chance for him.

No one need apologize for asking questions of us upon any subject. That is a part of our business, and we are never better pleased than when are able to help a young man on his way. We are here to help one another, and it is a positive pleasure to help those who ask help.]

THE RETURN BALL ET AL.

Editors Engineer:

I noticed in one of your recent editions a paragraph clipped from the *Western Machinist*, relating to the inventor of the returning ball and the fortune which he had made from it. The statement has gone the rounds of the papers for a number of years, and has probably been accepted as true by those who read it; but in that respect it very much resembles the Frenchman's definition of the crab, as a "little red animal that walks backwards," and which Cuvier, the eminent French naturalist, disposed of by saying that "except that it was not red, not an animal, and did not walk backwards, the definition was exactly correct." So in this case, with the exception that the man who invented the "returning ball" did not invent it, and did not make a fortune out of it, the above statement is absolutely accurate.

As a matter of fact, Mr. William Carr, a toy maker, of Brooklyn, gave his son a small wooden ball to play with. His son pulled a piece of elastic rubber out of an old suspender and attached it to the ball, making the first returning ball, so far as is known. His father "caught on" and had the thing patented, and his entire profits amounted to about four thousand dollars ($4,000.) The father, it may be added, was afterwards murdered by an ex-policeman in Brooklyn, who shot him with an air-gun.

The invention of toy building blocks, patented by C. M. Crandall, of Montrose, Pa., was made by his son Fred., and in this respect furnished a parallel to the return ball. Mr. Crandall was employed in a factory where lock-cornered wooden boxes were made, and one night took home a number of pieces with dove tailed ends which were too small for the purpose for which they had been made. When he awoke the next morning he saw his son Fred. building houses with the pieces, and straightway conceived the idea of patenting the building blocks, out of which a great deal of money was afterwards made. CHAS. H. DAVIDS.

Davids Machine Co., New York.

THE MUCH PUT-UPON ENGINEER.

Editors Engineer:

I have frequently read numerous articles pertaining to electricity, and its use in manufactures for illuminating purposes. In nearly all these articles reflections have been cast upon engineers, by saying that an engineer who did not have a fair knowledge of electricity and its appliances, must consider himself behind the times. Now, there have been rapid strides in the sciences and professions, also new appliances for the convenience, comfort, and safety of the public, which are put under the watchful eye of the engineer, and it seems to me that if a man does justice to his own profession as an engineer that it will consume nearly all of his leisure moments to keep pace with the progress made in it. Would it be right for a man to neglect other useful matters, essential to his business, and devote his spare time to the study of electricity or some other science? Electricity is a department by itself, and should be kept so. Nearly all steamers provided with an electric light plant have also an electrician, who looks after and assumes all responsibility connected with his branch. This is the way it should be. Why ask an engineer to look after everything when his own calling demands all his attention if he is conscientious in the discharge of his duties? The engineer of twenty years hence will have a big load to carry, and but few spare moments to prepare himself for it. F. S. B.

Ithaca, N. Y.

IN MEMORIAM.

AT a regular meeting of M. E. B. A. No. 50, held at their rooms, 285 Hudson Street, New York City, on the evening of Oct. 21, 1890, the following preamble and resolutions were adopted:

Whereas, The dread messenger, Death, has summoned to eternal rest our esteemed brother member, William Quigley:

Resolved, That it is meet that we pause in our labors and testify our sense of worth and appreciation of the character of our departed brother.

Young in harness, he won by his upright conduct and quiet demeanor our esteem and love. To the afflicted family, we tender our earnest sympathy in this hour of sorrow, and commend them to Him, the All-Merciful, who noteth even the fall of a sparrow.

Resolved, That in memory of our deceased brother we drape our altar and charter for a period of thirty days; that these resolutions be spread upon our minutes, and a copy sent to the family of our lamented brother.

ANDREW M. LESTER, Pres.,
G. MARION WHITE,
JAS. H. SIPPERLY,
WM. S. HOLTEN,
Committee.

FLYING MACHINES.

Editors Engineer:

In THE ENGINEER of Sept. 27, 1890, I see that Hiram Maxim will spend $10,000 on an air ship of his invention. Herewith is a rough sketch of the coming air ship, for the benefit of Mr. Maxim or any one else. She is to be made of platinum, built with gas-tight compartments to hold a certain gas to lift 3,000 lbs. more than her own weight; when once charged this gas is permanent. This ship is not like the old balloon; it don't lose its lifting power, and does not need to be charged after each trip. The engines can be used for lifting or driving power, and can attain a speed of 300 miles per hour, and keep it up for a month if required. There is no need of parachutes or life saving rigs, for if, at any time, the engines stop, she can float in the air as a ship on the water, or be lowered gently to the earth by easing the gas from one of her many compartments.

San Pedro, Cal. G. S.

[Possibly our correspondent means aluminum for the hull of his air-ship. Platinum is now one of the costliest of metals. We should like to have had a little fuller details of this vessel. The sketch sent shows nothing but what has been published many times, a screw propeller and fan-tail.—EDS]

OVAL PISTONS IN ROUND CYLINDERS.

Editors Engineer:

A MAN who takes pleasure, as I think, in getting up mechanical puzzles, says he can make an oval piston work in a round cylinder, and have it as oval as he likes—like an egg if he wants to. Please tell me if this is a catch, or a fact.

New York. PUZZLED.

[It is a fact. Cut a twig in a slanting direction, and you will see that the section will be an oval, and a piston of that shape will work in a round cylinder; a line drawn around the packing rings would be at an angle with the axis of the cylinder, or, in other words, the piston would stand at angle with the axis of the cylinder. An egg is not an oval, but an ovoid, one end being larger than the other.]

A CORRECTION.

Editors Engineer:

In the last issue of THE ENGINEER you stated that I am layer-out in the Lake Erie Boiler Works, this I hope you will be kind enough to correct, as it would be an injustice to the present and past layer-out. Since I commenced to work for the Lake Erie Boiler Works I have had charge of the sheet iron department only. Mr. John H. Howard was the former layer-out, and the present is Mr. M. Maher in the boiler shops. What laying out I do is in the sheet-iron shop, and that keeps me busy. JOHN COOK.

Buffalo, N. Y.

A GOOD THING, THIS.

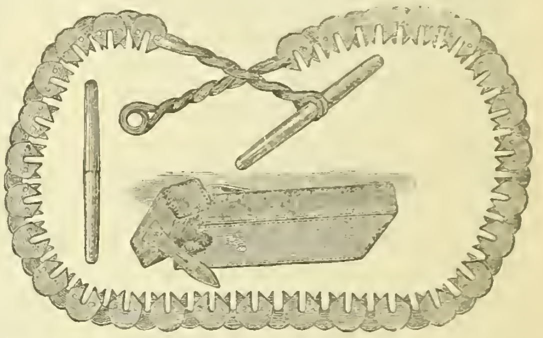
Editors Engineer:

Inspirators and injectors, especially those with working parts, require lubricating frequently, and I find nothing better for the purpose than the Colgan Lubricating Ball. It imparts to the internal surfaces a "glib" not easily worn away, and is a sure preventative against corrosion and scale forming in the jets. The lubricant also increases the capacity of injectors in a slight degree. "QUID NUNC."

Bridgeport, Conn.

STANLEY'S PATENT PORTABLE SAW.

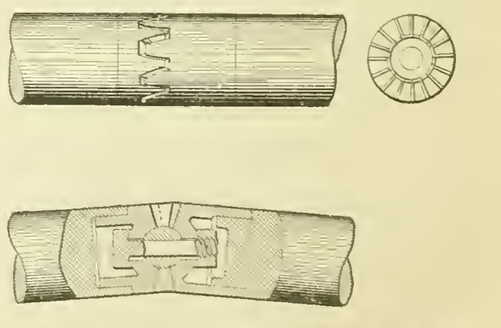
THE ingenious tool shown in the illustration herewith has been specially designed for the use of surveyors, miners, railway pioneers, and engineers, as well as for military purposes. It is made of hardened steel plates, riveted together in double series, the rivets being sufficiently loose to form joints.



Each plate is shaped to form saw teeth, cutting in opposite directions. Rings are provided for the cross handles, but in inaccessible places ropes can be attached. The saw can be packed in a very small compass, the case containing it being 8 × 4 × $1\frac{3}{4}$ in. only, its weight being $2\frac{1}{4}$ lbs. This tool is considered to be fully equal to a 6 ft. cross-cut saw, and it can be used by one man only. Recent experiments have shown that trees girthing from 4 ft. to 4 ft. 6 in. may be felled with it in from 5 to 6 minutes. With its advantages of extreme portability and handiness, this ingenious tool is eminently suited for its purposes.—*Mechanical World.*

UNIVERSAL SHAFT COUPLING.

A SIMPLE method of coupling shafts to allow for a considerable deflection in them has recently been patented in England, as shown in the illustration taken from *Industries*. There seems to be no occasion for so many teeth in the ends of the couplings; half the number would be stronger and work just as well.



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A REVIEW.

OCCULTISM AND THEOSOPHY.

An exposition of the truths of Nature. JOS. M. WADE, Boston, Mass.

IF we need any proof of the wisdom that created mankind, we can find it in the variety of opinions held upon all subjects, for if we all saw things in the same light life would be harder. Those of us who think at all ravel out something from the tangled skein called life; others who do not think let the tangle alone, and worry along in their own fashion. Most men mould their lives after some scheme or plan which they have found best suited to their needs, and they pursue it with very little care or thought of what view others take. Still others are sure they have the clue to a better mode of life, and are not satisfied until they bring their fellows to their way of thinking. Most of us are content to get through the years allotted us without serious blunders or errors, and find plenty to do and to puzzle over in the material facts which surround them. Besides these there are still others who take no thought of this world, but are overburdened with what is going on in another, or, by what they call occultism; that is, things which are hidden or not revealed. The periodical under notice is intended *to point the way* (the italics are in the prospectus) to a better life, "as defined in Nature's teachings," etc. None of us have any reason to find fault with this intention, but it occurs to us that the following of any such periodical will be very small, for the reason that on this subject most people do not care for guidance, unless the guide is inspired from some other than an earthly source.

The muddle which men make of their own and other people's lives, when they undertake to look beyond the veil and lay claim to prescience, is lamentable, and our own view is that only mischief results. Is it not in a sense arrogant for men to claim that they alone have discovered the truth, and that others who do not think as they do walk in darkness? It seems so to us.

At the head of one of the articles in *Occultism and Theosophy* is this quotation:

> "The first to tread an unknown path
> Or dare a new truth to proclaim,
> Is, by the world's dulled realm of thought,
> Pronounced eccentric or insane."

And in the editors' prospectus, this sentence:

> "It will point the way, and give the key for the development of the spiritual man as against all illusions, and teach absolute peace under all conditions."

It would seem that the last line of the first quotation very fitly sets forth the mental status of a man who professes to be able to "point the way" and to "teach absolute peace under all conditions."

◆

DURING the work at the Innsbruck, Hungary, electric central station, a spider climbed on one of the lightning protectors. This occasioned an earth connection, and an induction bobbin was damaged by the breaking of the insulation. In order to prevent future accidents the lightning protector plates are to be closed up in glass boxes.

◆

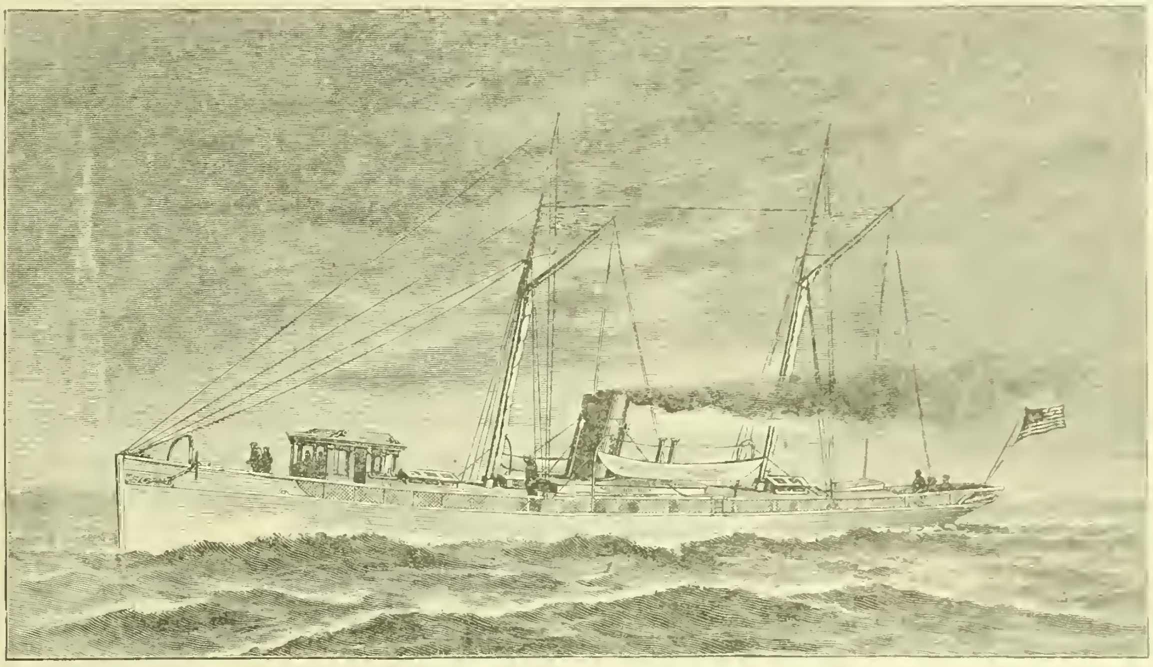
THE word zero is from the Spanish, and means empty, nothing. It was first used on a thermometer in 1709 by a German physicist named Fahrenheit.

TRIAL OF THE HYDRAULIC JET BOAT, 'EVOLUTION.'

THE new boat of Dr. W. M. Jackson, called the '*Evolution*,' propelled by a very small water-jet under very high pressure, went on a trial trip on the 9th ult., in New York harbor, and is reported as operating very well, although she came far short of attaining the great speed anticipated by her owners.

In most of the experiments heretofore tried with the hydraulic jet as a propeller, the endeavor has been to make use of as large a jet as possible, economy of power being obtained this way, as was believed.

Dr. Jackson instituted a series of experiments by which he became satisfied that previous experimenters had traveled the wrong road, and that the correct plan was to use a very small jet of water under a very high pressure. To carry out this idea, in 1887 he fitted up a small boat named the '*Primavista*,' 50½ ft. length, 5½ ft. width, and 3 ft. draught. She had a discharge jet only a quarter of an inch in diameter. The water was expelled under a pressure of 690 lbs. to the square inch, and the boat is stated (by parties interested in selling the stock of the company) to have attained a velocity of ten miles per hour. The alleged success of the '*Primavista*' satisfied Dr. Jackson, and under the guidance of a stock promoter, a company was formed to build a new vessel, large enough to demonstrate the great superiority of the high pressure jet over all other methods. Over $100,000 was contributed toward the new enterprise, among the subscribers being a number of our best business men.



They were given to understand that the new plan was likely to effect a complete revolution in the art of propelling ships, a great increase of speed would be attained, and the time-honored theories of marine engineers would be upset. It was on this basis the '*Evolution*' was evolved, and her speed was to be at least thirty miles an hour. She is 106 ft 6 in. length, 23 ft. beam, 3 ft. draught, and 100 tons displacement. She is propelled by a 44 inch Worthington steam engine and pump, a Roberts safety-tube boiler, 1200 i.h.p. water jet discharge, 1000 gallons per minute; velocity of jet, 609 ft. per second; diameter of jet, ¾ of an inch; hydraulic pressure on the jet, 2500 lbs. to the square inch. These figures have been furnished to us by parties interested, but we have had no opportunity of verifying them, as scientific reporters cannot at present be admitted on board.

The man who expects to beat the best types of propeller boats by means of a ¾ inch jet of water has a hard row to hoe. The indications are that the '*Evolution*' cannot come up to the scratch. She has had a preliminary trial under low pressure. She has made a voyage down the harbor and back, say 25 miles, and has achieved, as we are informed, a velocity of ten miles an hour, with a hydrostatic pressure of 500 pounds per square inch on the propelling jet. The horse-power used on this trial we have not learned, but suppose it to have been about 250 h.p., and if so the boat will not, when running under full pressure, have any such speed as her owners have claimed. So far as tried she seems to have done as well, perhaps better, than other jet boats, considering the smallness of the jet.—*Scientific American.*

◆

SOME experiments were recently made with the object of determining the best way of anchoring bolts in rock. Fourteen holes were drilled in a ledge of solid limestone. Seven of them were 1⅛ in. in diameter, and seven 1⅜ in. in diameter. Seven ¾ in. and 1 in. bolts were then prepared with a thread cut at one end and plain at the other, but jagged for a length of 3½ ft. from the blank end. Four of these bolts were anchored with sulphur, four with lead, and six with Portland cement mixed neat. The cement was allowed to harden two weeks, after which the bolts were pulled out by suitable arrangements. Of the bolts fixed with sulphur three stood a pull equal to their tensile strength; the fourth, an inch bolt, drew out at a load of 12,000 lbs. Of those secured by lead three again developed their full strength; the fourth, an inch bolt, pulled out at a load of 13,000 lbs. With the cement five out of the six broke without pulling out. The sixth, an inch bolt, yielded under a load of 26,000 lbs. These experiments proved cement to be not only cheaper than lead and sulphur for securing bolts, but also considerably more efficient. Some further experiments on a plain cylindrical 2 in. bolt led to the conclusion that the cement had a holding power of 400 lbs. to 500 lbs. per square inch of bolt surface.

◆

ROBERT CARSON, of Hull, in writing to a foreign paper, mentions a practical illustration of the advantages of quadrupling his experience with the steamship '*European*.' The old engines, he states, were a good economical working compound, indicating about 480 i.h.p., the average consumption of coal for all purposes for the voyage out and back being 32 tons. After quadrupling, and replacing the boiler by one of his design, the engines indicated 540 h.p., and the consumption of fuel was reduced to 20 tons per voyage for all purposes. He advises shipowners to quadruple their old engines, and enable old vessels to compete with modern. Another important saving results from the reduction in dead weight carried by the vessel.

◆

THERE is to be no diminution of activity in the lake shipyards this winter. The various yards at Buffalo, Cleveland, Toledo, Detroit, Bay City and Duluth, are all busy; and the contracts already placed, according to the *Marine Review*, include 29 steamships and 5 steel barges, having a total capacity of 81,600 tons. Seven of the steamers only are to be of wood; the remaining 22 will have steel hulls. Besides these, other contracts are pending, which will probably bring the total up to over 100,000 tons.

◆

No water pipes are fitted for cooling off bearings on the '*Cushing*,' U. S. N.

THE ENGINEER.

FORTNIGHTLY. · · · $2.00 PER ANNUM.
Foreign Subscriptions, - · · · · · 2.50.

EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK, NOV. 8, 1890. NO. 10.

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STEEL CASTINGS.

THE first so-called steel castings used commercially in this country were introduced by Philip S. Justice, formerly of this city and Philadelphia, but now residing in London, England. These castings were made by the McHaffie process, a Scotch invention which was introduced in Glasgow first, and from thence brought here. These castings were "white iron," so-called, melted in a cupola the same as iron, and cast in sand, also the same as iron. When they came out of the flask they were as brittle as glass, and were put through an extended annealing process to reduce the carbon and make them tractable. This is exactly the process of making malleable iron, and this was, in fact, the nature of the McHaffie (alleged) steel castings in 1870-'72. They were malleable iron of superior quality—when sound, but the greatest trouble existed in making them sound in large details. Small castings, wrenches, etc., were easily executed. We made a market for these goods in some lines, and know whereof we affirm. Among other things we placed an order for three large pinions, 30″ diameter, 12″ face, six inch pitch. These were for the Mount Washington Rack Railway, and sustained the whole weight of the train. They looked very fair when they came out (they were made in Glasgow), and rang like steel bells when struck with a hammer. Unfortunately, (or fortunately) we struck one of the great teeth pretty hard, and knocked it clean off the pinion. Upon examination the tooth proved to have walls about ⅛ thick; the interior instead of being solid metal was a mass of cinder and scoriæ. We proceeded to knock the rest of the teeth off without any trouble. We made for R. Hoe & Co., of this city, a casting for an hydraulic cylinder 12″ diameter, warranted to stand as much as a wrought-iron forged cylinder of the same size. The steel-cast cylinder burst under a very moderate pressure, and came near killing four or five men. We made a set of links for a locomotive for the Connecticut River R. R., John Mulligan, M. M. (at that time). These finished up beautifully without crack or flaw, and were tempered in oil. They were left on the bench in the shop, and before the next morning they had burst into a dozen pieces. We could recite numberless cases where these castings, when put to the test and the work there were alleged to perform, failed utterly. They were in fact malleable iron masquerading as steel.

As to where steel begins and iron ends we say nothing. We do not know, neither does anyone else, but crucible steel cast in the sand as cast-iron is, behaves at this time as it always did. It is stubborn, viscid, clings to and tears up the face of the moulds, and chills quickly. This renders it unreliable for cast shapes, for they are as full of holes as a piece of ginger cake, and as full of varying initial strains as they can be. This is the behavior of ingot crucible steel when it is cast in sand. A bastard alloy steel, so-called, is made by using certain agents which increase the fluidity of the steel and render it possible to pour it to shape, but these agents reduce its tensile strength materially. We were in a large Eastern machine works some years ago, when the proprietors pointed out to us that the boxes on the main bearings of their large milling machines were made of steel castings hardened. We asked if there had been no trouble with them, and the proprietors assured us that there had not. Upon examining these boxes closely, we found that every single one of them was cracked through and through, and were only kept in place by the housings.

There was made for the '*Maine*,' U. S. N. cruiser now building, two outboard hangers for the shafts, both of these steel castings have had to be removed from the fact that large blow holes existed in them.

Steel castings, so-called, are capable of being twisted, tortured, bent, hammered hot and cold, drawn out and hardened but so is good malleable iron, and between the alleged steel casting and the *de facto* malleable iron of the best quality, there is little difference except in the price. The steel casting is much more costly.

◆

THE SMALL SHOP.

MANY mechanics are striving to get forehanded enough to establish their own shops, hoping that in time they will grow into larger works, where they can execute heavy contracts. This is a laudable ambition, but it happens sometimes that men go into these enterprises with the expectation that the shop will grow of itself, and that the public will seek them merely because they have shops. It should be borne in mind that nothing is to be had in this world without labor and pains, and that if a shop becomes known and has an established reputation, it is because some one is interested in pushing it. By whatever means it is secured, publicity must be had, for it is indisputable that people cannot give work to shops they do not know of. This point is one that escapes the attention of the average craftsman in any line, but particularly of engineers and machinists. If men want new or old work to do in their shops, they must go where such work is to be had. Too many, however, wait for the work to come to them, and wait in vain usually, because someone in the same line, with more enterprise, has got ahead of them. It is queer, but it is true, that some mechanics will not hunt up work, because they cannot get rid of the feeling that they are asking favors of strangers. This is absurd. There are no favors in trade. If a man gets a contract it is because his terms are favorable to the buyer, and for no other reason. No manufacturer gives contracts for "love and affection," as wills are sometimes made.

Another mistake small concerns make is in assuming that they will be paid for their labor so soon as the work is done. There are, unfortunately, such things as bad debts and slow paymasters in this world. There are persons who are amply able to pay, and who have the money at hand to meet any bill, who will not pay simply because they are contrary, and like to put others to all the annoyance they possibly can. These drawbacks to prosperity the man who starts a small shop must consider beforehand, for, like all others in trade, he will be sure to encounter them sooner or later.

It is not the small beginning which is in doubt, but the small beginner. Is he the man to succeed?—this is the question. Has he the faith which will remove mountains, the courage, the courtesy, the business tact which will command success? If he has, it makes no difference how small the shop is on the start. A small shop with a large man in it will succeed, where a large shop with a small man in it will fail.

◆

"THE WHITE SQUADRON."

THE beautiful new naval vessels recently added to the service of the United States will have very full illustration in future issues of THE ENGINEER. We give, in this, one of the handsomest in a sailor's eyes—the '*Chicago*'—and shall present all of them now afloat in due course. Some of the new vessels are peculiar in appearance, being without spars or rigging, so that they somewhat resemble Atlantic liners. The vessels were known on their recent cruise abroad as the "White Squadron," all of them being painted snow white, and this is such an appropriate title that we have retained it.

◆

AN electric street car, containing about seventy-five persons, was moving along Market Street, Newark, on the 26th, when the armature burned out, and the flames caught the car floor and burned through. There was a momentary panic among the passengers, and after a lively scramble they were all in the street, and the car was in a fair way to be totally destroyed. This is the second occurrence of the kind in a short time. Too much cheap labor, probably.

OLD INVENTIONS CALLED NEW ONES.

It is curious to note the application in the trades of devices that have in one form or another been used in household service so long that they are familiar to those who take note of such things. Here is a case in point. A foreign paper says that:

> "The Gamgee Steam Generator Company of England are introducing a novel appliance, the invention of Mr. John Gamgee, and intended to promote active water circulation in steam boilers fitted with Galloway tubes. The appliance is a cowl fixed on the top of each Galloway tube, without, however, interfering with the structure of the boiler, being simply held in place by screws. This cowl causes the circulation to become general instead of local, the water being drawn from the bottom of the Galloway tube and carried to a height some inches above the normal water level in the boiler, where it is allowed to escape from the lip of the cowl in a continuous thin stream, presenting special facilities for the disengaging of the steam carried up in the stream of water. This action reduces priming, and ensures increased circulation, the cowl drawing its supply from the hitherto dead water below the flue and discharging it in forced jets above the water level. The active circulation secures uniform temperature in all parts of the boiler, and conduces thereby to its preservation and greatly diminishes the deposition of scale."

Precisely this device has been in use in this country for years past on "wash boilers," so called for domestic purposes. A false bottom, which can be lifted out, has a tube rising perpendicularly from it, terminating in a nozzle which turns toward the bottom of the boiler. The false bottom does not fit tightly and the water gets underneath it. Upon the top of the false bottom the clothing to be washed is placed. When the boiler is on the fire the heat drives the water up the tube, from whence it issues at the top again, pouring scalding water over the clothes continually. This may not interfere with the patentability of the device for steam boilers, but it nullifies its novelty.

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IRON-BOUND ENGINES.

Last week we saw a man take hold of the flywheel of a new fifteen-horse vertical engine, and pull it round with one hand; when the crank was over the top center, the piston ran down by its own gravity, and that of its connections. The engine was ready for steam.

"That's the way we do it here," he said.

"Is the piston tight?" we asked.

"Tight!" was the the retort, "it's tighter than if it was cast in."

"What sort of packing is in the piston?"

"Snap ring."

Of course the piston packing alone did not give the freedom from friction that we have mentioned, but it conduced to that end greatly, for a ten inch piston can grip a cylinder very tightly when the packing is plugged out with a long wrench or a hammer and chisel, which last we have seen used for packing a piston. The surfaces in contact, and the alignment, had a great influence on the action, for unless there is mechanical exactness and accuracy there cannot be good performance. The facts are that too many persons suppose that an engine cannot be tight unless it is screwed up tight. Some engines, we are free to admit, cannot be made tight then, but any engine that is properly built and adjusted needs only to have the surfaces brought into intimate contact—not forced contact—to perform properly. Strange as it may seem to some, engines pound as often from having every part iron bound as from improper valve setting. The iron bound engine cannot pass its centers easily, because every part is so stiff that the least play or slackness in the bearings makes a noise.

A very large proportion of the engines in daily use are iron bound.

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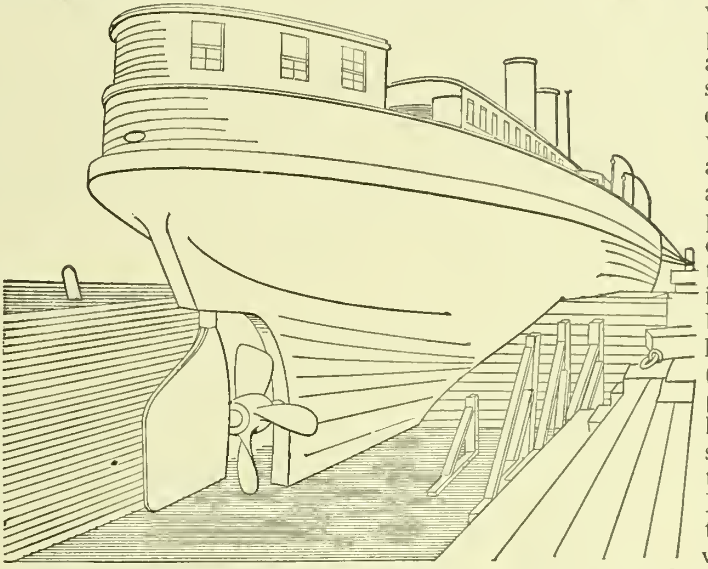
We wish to have a great many new subscribers this year, and invite all who can spare a little time after business hours to send for our circular of cash rates to canvassers. Any large town should afford a good field. All classes read The Engineer.

AN INGENIOUS EXPEDIENT.

Frank E. Kirby, consulting and constructing engineer of the Detroit Dry Dock Company, has favored us with a photograph and the details herewith of a clever expedient for repairing a stern bearing.

The steamer *'St. Ignace,'* required to be drydocked to renew the stern-bearing, her draught was two feet greater than the depth of water on the gate sill of the dock, and Mr. John C. Parker, superintendent of the dock, designed and executed the following plan of docking the stern of the ship only.

The gate was closed and the dock pumped dry. A partial gate or bulkhead was then built across the dock close to the permanent gate as practicable, with a gap in the center exactly the shape of the ship's at a point 25 feet forward of the stern-post. A packing of oakum and canvas was secured on the edge of the gap to make a water-tight connection with the bottom of the ship. Sufficient weight was placed on the bow of the ship to trim the stern up to the proper draught She was then hauled back into the gap and fastened with hawsers and shores. The pumps were started and the dock freed of water; the work proved perfectly tight; provision was made to keep the bow in proper trim by letting in or pumping out water ballast.



Of course the plan would be impracticable at a tidewater dock.

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AMMONIA.

Our knowledge relative to the chemical nature of ammonia dates from the year 1774, when it was discovered by Priestley, who called it alkaline air. Ten years later Berthollet succeeded in determining its approxmative composition, which upon further investigation led at the beginning of this century to a true cognition of its chemical constitution. Though the process for making ammonia is of a late date, some compounds, especially sal ammoniac, were well-known as early as the eight century by the Arabian, Geber. From the fifteenth to the close of the eighteenth century this salt was exported from Egypt, which supplied whole Europe with it.

Of the raw materials that enter into the manufacture of ammonia and its salts certain sorts of coal furnish the main supply; animal substances, flesh, bone, blood, and urine, though rich in nitrogen, are of secondary importance. The crude material being subjected to dry distillation, generates illuminating gas, coke, or boner black, respectively, with the eliberation of ammonia as by product. Also spent products from the manufacture of beet sugar are used in making ammonia; cyanogen, and its compounds, prussiate of potash, have been converted by means of superheated steam into ammonia. The guano deposits of Chili, Peru, and Bolivia, contain a great amount of ammonium carbonate, with a yield of about 20 per cent. ammonia. Sulphate of ammonia, of volcanic origin, is found on the borders of the Vesuvius, etc. Experiments to convert the nitrogen of the atmosphere into ammonia have led to no practical success.

One of the principal members of the series of alkalies—ammonia—is, regarding its chemical nature, distinguished from all others by being a chemical compound of nitrogen and hydrogen. (Under the influence of an electric current, or by passing the gas through a red hot tube, these elements are set free in quantities by weight of 14 parts nitrogen to 3 of hydrogen.) The physical constitutive also differs from that of its associates, potassium sodium, etc., in this respect, that at ordinary temperatures under atmospheric pressure it represents a colorless gas of 0.58890 density. (The density of the air being =1.) It has a pungent, penetrating odor, a caustic alkaline taste, and changes the color of certain organic pigments, litmus, lacmoid, from red to blue. Ammonia possesses a great affinity for acids, with which it produces the numerous compounds known under the generic name ammonia salts. Water absorbs the gas with avidity, yielding the liquor of ammonia, spirits of hartshorn. (The quantity of absorbed gas varies with the temperature, but exceeds at 60° F that of the water 725 times in bulk. During the process of absorption much heat is eliberated, the amount of which equals 8435 calorics (units of heat pro molecule or 17 parts by weight of ammonia). Alcohol, and of solid substances, silver chloride, calcium chloride, nitrate of ammonia, combine with ammonia more or less energetically. All these substances emit the absorbed gas completely upon the application of heat. A watery solution of ammonia discharges all the gas at the boiling point of water. Ammonia is a coercible gas, being convertible by pressure to a colorless mobile liquid, of 0.6234 density at 60° F. (density of water =1), with a boiling point at —28° F. (the liquid anhydrous ammonia of commerce). It solidifies at —124° F. to a colorless crystalline substance of a slight odor. Liquid ammonia absorbs upon evaporation a large amount of heat, which it withdraws from its surroundings: at 60° F. the quantity of heat absorbed equals 297.38 calorics pro 1 kgrm. of substance. A mixture of ammonia and oxygen in equivalent proportions burns with a blazing flame, and generates pro molecule, or 17 parts by weight of ammonia, 90650 calorics. The heat of formation of ammonia is thus equal to 11890 calorics.

The pressure of saturated ammonia vapor at different temperatures is as follows:

Temperature. (Fahrenheit)	Pressure. (In Atmospheres)
— 22°	1.14 at.
— 13	1.45
— 4	1.83
+ 5	2.28
+ 14	2.82
+ 23	3.45
+ 32	4.19
+ 41	5.00
+ 50	6.02
+ 59	7.12
+ 68	8.40
+ 77	9.80

One atmosphere = 14.70 lbs. engl. per square inch.

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We saw recently a system used in a large engine and boiler establishment for promoting detail work around the shop which seems worthy of adoption in large railway shops. At the desk of each foreman was a tin box, in which all communications for other departments were put. A messenger was detailed whose duty it was to keep moving from shop to shop, picking up and leaving mail in each of these boxes as he went through, completing the rounds generally within an hour. The result was that many questions were answered inside of that time, thus saving a great deal of time of the foremen, and obviating the necessity of their leaving their own particular shop. The results are said to be most gratifying.—*Master Mechanic.*

Foreign and Domestic Trade Literature

THE PROCESSES OF STEAM IN ITS DEVELOPMENT OF POWER BY MEANS OF A STEAM ENGINE.*

By Chief Engineer B. F. Isherwood, U. S. N.

The liquefaction due to the transmutation of the heat of part of the expanding steam into the work of expansion, is effected upon every molecule of that steam, and the resulting water, infinitesimal drops or flakes, continues suspended in the remaining steam, giving it the appearance of haze, mist, fog, or cloud, the opacity being the greater as the work of expansion is greater, whereas non-expanded steam, though doing work, is perfectly transparent. This form of liquefaction of the steam is just the same as previously described for the similar liquefaction due to the increasing latent heat that accompanies expansion. But there is this difference, that in the case of the increasing latent heats, the liquefactions were caused by the transference of *vis viva* from one portion of the steam molecules to another portion, while in the case of expansion doing work the liquefaction is caused by the transmutation of molecular *vis viva* into the mass *vis viva* represented by the load on the piston. But in both cases the final effect was the same, namely, the waters of these liquefactions were in the form of excessively comminuted spray as intimately mixed with the steam as its own molecules were intermingled. These extremely light particles of spray cannot, for want of time, and because of the resistance of the steam medium, precipitate by gravity upon the cylinder surfaces beneath; they, therefore, remain suspended in the steam and are swept out with it during the exhaust. Of course, the bulk of these waters of liquefaction was added to the bulk of the steam, which thus appeared by that much greater than it really was. The expanded steam, as has been shown, is *wet* steam, and *wetter* the more expansively it is used.

The two liquefactions that have been described are inseparable from the use of saturated steam expansively.

Thus far there has only been considered the liquefactions of steam which take place in the cylinder of a steam engine using steam expansively, independently of any liquefaction that may be effected by the alternate heating and cooling of the metal of the cylinder during a double stroke of its piston, caused by the expansive use of the steam. This latter liquefaction must now be considered.

Taking first the case of an engine in which the steam is used without expansion, and, therefore, dry; and supposing the cylinder at the commencement of the stroke of its piston to have the temperature of the steam entering from the boiler, then, during the steam stroke of the piston, there will evidently be no liquefaction of steam. When the exhaust valve opens, the steam is expelled by its own expansion from the cylinder into the condenser, where it is annihilated. During this expansive expulsion of the exhaust steam it does, owing to its expansion, molecular work, and undergoes corresponding liquefaction. As the exhaust steam does no mass work during its passage into the condenser, because it is there annihilated, it will suffer only the slight fall of temperature due to the molecular work of its expansion, and will therefore have but a trifling effect in cooling the metal of the cylinder. Hence, in the case of using steam without expansion, the interaction of the metal of the cylinder with the heat of the steam is very small, the temperature of the metal of the cylinder varying but little during a double stroke of its piston, from the temperature normal to the pressure of the entering steam. When the steam is used without expansion, the interaction of the metal of the cylinder with the heat of the steam is, therefore, very little during a double stroke of the piston.

Whatever temperature the metal of the cylinder loses during a double stroke of its piston, is restored to that metal by the steam entering from the boiler, which steam consequently undergoes a liquefaction corresponding to the quantity of heat thus transferred from it to the metal. The water of this liquefaction is uniformly deposited like a dew upon the inner surfaces of the cylinder and remains there to the end of the stroke of its piston, if the steam be used without expansion. When the exhaust valve opens and the pressure of the exhaust steam is lessened to nearly that of the space into which it is discharged, the deposited water of liquefaction is rapidly boiled off or re-vaporized under the lessened pressure, partly by its own contained heat, but principally by the heat of the metal on which it rests, taking from the latter an equivalent quantity of heat and reducing its temperature accordingly. The heat of vaporization of this water of liquefaction passes out of the cylinder with the exhaust steam and is lost.

The absolute dimensions of the cylinder are of importance in this relation. The larger those dimensions the less will be the liquefactions due to the heat interaction of the metal and steam, in proportion to weight of steam used from the boiler. For example, if all the dimensions of a cylinder be doubled, its surface will be increased four times, but its capacity will be increased eight times. In this case the influence of the surface on the liquefaction will be halved, relatively to weight of steam used from the boiler.

The loss of heat by the metal of the cylinder in the case of using the steam without expansion, is then of two kinds: (1) That of the heat extracted from the metal and carried out of the cylinder by the exhaust steam, due to the slight cooling of that steam by its molecular work during its expansion into the condenser; and (2), that of the heat of vaporization of the water of liquefaction caused by the above abstraction of heat from the metal, having to be restored by the entering steam, which suffers in consequence a corresponding liquefaction.

When, however, the steam is used expansively, doing external work, the liquefactions of the steam in the cylinder rapidly increase as the measure of expansion increases. After the closing of the cut-off valve, the temperature of the metal of the cylinder being supposed to be then equal to that of the steam entering from the boiler, the pressure and temperature of the steam decrease continuously to the end of the stroke of the piston, and, as a consequence, the expanding steam continuously abstracts heat from the metal of the cylinder from the commencement to the end of the expansion. During the entire expansion the steam is in the saturated state, notwithstanding the fact that its temperatures at lower pressures are less that at higher ones, because the heat transmuted into the work of the expansion is greater than the heat due to the differences of temperature. Were the opposite of this the case; that is, were the heat transmuted into the work of the expansion less than the heat due to the difference of temperature for the expansion, the expanding steam would become superheated, and there could be no liquefaction resulting from the expansion. Such, indeed, is the fact in the case of steam at exceedingly high pressures and correspondingly high temperatures. There is a pressure—far above what can ever be employed in practice—at which inversion of these relations takes place, the heat equivalent of the work of expansion being then less than the heat due to difference of temperature; and superheating instead of liquefaction, would, under that condition, be the result of using the steam expansively.

Returning to the expansion of steam under practical conditions. As the pressures, and, consequently, the temperatures of the steam fall with the expansion, the steam becoming wetter and wetter, too, the further the expansion is carried, having its heat interacting power with the metal continuously increased in proportion to its increasing wetness, the metal of the cylinder is continuously cooled, keeping pace with the lessening temperatures of the expanded steam, until when the end of the expansion, or end of the stroke of the piston is reached, the temperature of the metal and that of the steam at the end of the stroke of the piston are equal, if not to the entire depth of the metal, at least to a considerable part of that depth. Now, when the piston is at the end of its stroke, the metal of the cylinder has been reduced from the temperature of the steam entering from the boiler, which it had at the closing of the cut-off valve or commencement of the expansion, to the temperature of that steam after its expansion was completed. The exhaust valve now opens, and if the steam has not been expanded to the condenser pressure, a further expansion then takes place to nearly that pressure, and the heat of the revaporization of the water of liquefaction present in the cylinder at the end of the stroke of its piston, under this lessened pressure of the condenser, being chiefly abstracted from the metal of the cylinder, reduces the temperature of that metal to nearly the temperature of the condenser. The whole of the heat required to raise the temperature of the metal from the temperature of the condenser pressure to that of the entering steam, must be restored from the heat in the latter, which, of course, suffers a corresponding liquefaction in furnishing it. The whole of the water of this liquefaction is present in the cylinder when the cut-off valve closes, and has the temperature of the steam from which it was derived. From the closing of the cut-off valve it commences to revaporize, and continues to boil off during the succeeding expansion portion of the stroke of the piston, and during the return stroke while the exhaust valve is open, if any remains not vaporized at the end of the expansion part of the stroke, the whole disappearing in vapor from the cylinder by the time the exhaust stroke is completed. There is no water in the cylinder on the exhaust side of the piston when the latter reaches the end of its stroke; were this not the case, there would be an accumulation of water in the cylinder that would soon stop the engine.

(*To be continued.*)

PREPARED SEA WATER FOR USE IN MARINE BOILERS.

In the old form of marine boilers, working at low pressure, sea water was almost entirely used, and, although considerable incrustation was the result. causing waste of fuel and deterioration of the boiler, still it was considered better to put up with this than to face the expense of supplying the boilers with fresh or distilled water: but with the introduction of high-pressure tubular boilers, the amount of deposit formed was so serious, and the difficulty of cleaning out the deposit from between the tubes so great, that it became almost imperative to discontinue the use of sea water rather than to risk the burning and destruction of the tubes and plates in inaccessible portions of the boiler, which could only be removed when time could be spared for a complete clean out and refit.

In 1889, Professor Lewes, of the Royal Naval College at Greenwich, read a paper at the Institution of Naval Architects which created a considerable amount of interest, and in which he traced the formation of the various kinds of boiler deposit, and pointed out that it was possible to so prepare sea water that it should give no incrustation unless evaporated to a density at which the salt itself would crystallize out; and, having devised an apparatus for this purpose, Mr. J

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* A lecture delivered before the Sibley College of the Cornell University, Ithaca, N. Y.

H. Biles, the general manager of the Naval Construction Works, Southampton, determined to try the process in a boiler working a crane on one of the jetties in his yard, in order to practically determine if the method would give the results claimed for it.

The boiler was kept under steam for a month, using nothing but prepared sea water, and blowing off the steam when it was not required for other purposes, and was opened on Wednesday, September 10, in the presence of a representative gathering of gentlemen interested in the subject, including Mr. W. H. Riley, R.N.; present on behalf of the Admiralty, Mr. J. T. Milton, representing Lloyd's Register, Mr. Dusantoy, representing the Union Company, Mr. Biles, Mr. Gearing, Mr. Archibald Thomson, and Professor Lewes, and it was found that the result was in every way eminently satisfactory, the interior of the boiler being in perfect order and free from any trace of incrustation or scale, the plates merely looking as though they had received the thinnest possible brush over of whitewash.

The water used in this experiment was drawn from the Itchen a short period before high tide, and enough was stored in a large tank to last for the day's consumption, and on analysis, this water proved to be practically sea water contaminated with sewage, and containing a large proportion of suspended earthy matter, which, under ordinary circumstances, would have given an extremely heavy incrustation. The water was pumped a ton at a time into the precipitating vessel, which consists of an egg-shaped boiler placed on end, with a small man-hole at top for the introduction of the precipitating materials, and fitted below with blow-off cock, a tube to lead away prepared water, and a pipe through which steam can be blown into the contents of the boiler, or "precipitator," as it is called.

The water having been introduced, exhaust steam is blown into it until the boiling point is reached, and the "precipitator powder," made up in packets of the right size, is then introduced through the small man-hole, and entering into solution in the water, at once throws down all the lime and magnesium salts which are present, in the form of a white flocculent precipitate. The action, however, is not yet quite completed, and the precipitate is not dense enough to settle rapidly; these points being attained by closing the man-hole and blowing in steam until a pressure of 10 lbs. is obtained in the precipitating vessel, and if this pressure is maintained for a short period the precipitate becomes very dense and rapidly settles, merely leaving a slight turbidity, which is got rid of by running the prepared water through asbestos cloth in a filter-box. The water so treated contains nothing but sodium salts, which, being excessively soluble, will not form any deposit until sufficiently saturated for the salt itself to crystallize out, a point which is only reached when the density has become over 1.2, or 7-32 on the salinometer.

The advantages of prepared water for use in marine boilers are, in the first place, cheapness, as the preparation only costs 1s. to 1s. 2d. a ton, or less than is paid at many ports for ordinary fresh water, and far less than distilled water can be made at by any process. Secondly, it saves the carriage of either considerable quantities of fresh water or else of complicated distilling plant, whilst it is preferable to distilled water, the solvent action of which upon metals is a distinct drawback. Thirdly, it not only does away with all incrustation, but, by also removing the magnesium salts present in the water, prevents pitting, and does away with the necessity for zinc in the boiler, and, finally—the density of the prepared water being less than that of sea water, and it being possible to evaporate off a much larger proportion of it—the loss of heat, by blowing off, is very small; and, as the exhaust steam used for heating the sea water is all condensed and passes back with the prepared water, which is at the boiling point, to the hot well, loss of heat is also here avoided.—*Shipping Gazette.*

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LAKE SUPERIOR COPPER MINES.

Few people have any knowledge of the native copper of Michigan, nor is the magnitude of the industry understood. Last year there were produced 105,586,000 pounds of refined copper, which, at 17 cents per pound, would amount to the sum of $18,045,620. It is a rapidly-growing industry, and the new openings and additional machinery, now fast getting ready for operation, point to an increased production of at least 25 per cent. in pounds of copper for next year.

About $250,000,000 in value have been taken from these famous mines, and yet no one suggests a probable limit to the supply. Native copper is so called because each particular piece, as it is mined, whether it be tons in weight or a fine particle of dust, is pure copper, of the same kind as the ingot copper of the world's markets. It is not alloyed with any other mineral except a trace of silver.

It was the purity of the metal that made these mines an object of interest to an ancient people, who worked them in some prehistoric age.

Ancient works have been found at numerous points for about thirty miles. There is a deep mystery about these old works that it is impossible to fathom. In the opinion of many they were worked by men that preceded the time when Columbus discovered this continent, but others think that they were worked by the ancestors of the Indian races here when white men first penetrated this then far-distant country. This question can never be conclusively settled. This much is certain, that, whoever worked these mines in ancient days, all knowledge of the existence of the mines was gone from the Indians when white men rediscovered them.

These ancient miners seemed to know nothing of smelting copper, for there are no traces of molten copper. They were after pieces suitable to work by cold hammering into useful articles. They understood the use of fire to enable them to break away the rock from the masses of copper. They knew nothing of drilling or blasting, but used the stone hammer freely. More than ten cart loads of stone hammers were found in the vicinity of the Minnesota mine. One of the larger class weighed thirty-nine and one-half pounds, while smaller specimens weighed five or six pounds each.

These stone hammers have a crease around them for a withe handle. Ashes and wood coals have been found on the rocks at the bottom of the working, showing the use of fire to prepare the way for the stone hammer. These mines must have been worked for centuries, judging by the extent of the works.

In one place the excavation was about 50 feet deep, and at the bottom were found timbers forming a scaffolding, and a large sheet of copper was discovered there. In another place in one of the old pits was found a mass of copper that weighed forty-six tons. At another point the excavation was 26 feet deep. In another opening, at the depth of 18 feet, a mass of copper weighing over six tons was found raised about five feet from its native bed by the ancients, and secured there on oaken props. Every projecting point had been taken off by these people, so that the exposed surface was smooth.

Wherever the ancients found copper, from a few pounds to a few hundred pounds in weight, they were obviously able to utilize them, but the large masses were too heavy for them to handle. Many of their workings are ten feet or less in depth. The copper obtained by these people was wrought cold into axes, chisels, knives, spear heads, arrow heads, bracelets, buttons, beads, etc. It is a singular fact that very few of these articles are found near the mines.

The desire to fix a time when these old works were closed is intense. It would be curious to compare the civilization of Europe with that of these people at the same time, if we could fix the date. What was Europe doing when these stalwart men of the Northwest were swinging those tons of stone hammers in a no mean effort to accomplish a feat of mining that would have been creditable a few years ago to our boasted civilization?

A copper rock now on the Government grounds in Washington has a strange history. It was brought from the banks of the Ontonagon River. It is supposed to have been removed by the ancients in some way to the banks of the river, and, in an attempt to raft it over, it got away from them and sank to the bottom. When the water was low it projected above the surface and was an object of religious veneration. It is said to have been known for over two hundred years. The Jesuits heard of it from the Indian priests, who, however, refused to conduct the missionaries to the spot where it lay, on account of a superstitious belief that when the white men had seen it the Indians would be destroyed, a belief not without reason.

In 1820 General Cass sent a party of men to fetch the rock away, but, owing to its great weight, they did not succeed. Another attempt was made to remove it in 1827, but as the river was high and it was pretty much covered with water, this attempt failed. In 1842 another attempt was more successful. It was removed to the mouth of the river. A Mr. Eldred claimed to own it. It was afterward claimed by a Government agent, and finally removed to Washington. By act of Congress, Mr. Eldred was paid $5,655 for it.

The masses of copper found in the earlier days have not been equaled in size in later years. In fact, large masses of copper are not as profitable to find, owing to the difficulty and expense of getting them out and cutting them up. Among the numerous masses of copper, the most notable was found in the Minnesota Mine, in 1857. It was difficult to dislodge it from its native bed. Charges of powder, first of 125 pounds, gradually increased to 550 pounds, failed to dislodge it. Finally a charge of 750 pounds, securely tamped under it, was fired, with the result of lifting from its bed without fracture a mass of copper 46 feet long, 18 feet in breadth, and 9 feet thick, the two latter measurements being taken at the greatest distance, the whole mass weighing about five hundred tons

The greatest mine for many years has been the Calumet and Hecla. The development of this mine began about 1867. Its progress has been wonderful, and to-day it ranks as one of the greatest copper mines in the world. Its works are situated on what is locally known as the Calumet and Hecla Conglomerate.

Modern methods of mining and milling have made great advances over old methods.

The rock is no longer roasted. That method was abandoned years ago. Black powder has been superseded by high explosives that throw down much larger masses of rock. The hand drill has given place to drills driven by compressed air. All the rock is stamped in mills of great power. In 1860 a report was made of a mill that stamped thirty-three tons per head per day. Now a single head will stamp 260 tons per day.

The method of procedure is to raise the rock to the surface in such lumps as it is left in by the blast in the mine. Here the large pieces are put through stone crushers that break it into lumps not larger than a man's fist. It is then dumped into cars and taken about four miles, to the border of a small lake, where it is stamped and washed, a process called milling. After the earthy matter is worked out as far as practicable, it is sent to the smelter, where it is cast into the various forms of copper required in the markets of the world.

The people, who live almost together upon the group of mines, of which the Calumet and Hecla is the principal one, number about 12,000, all of whom are either directly or indirectly supported by the mines. About half as many more are supported around the mills and smelting works.

All the mines have to pump the water up to their mills to wash the earthy matter from the copper. The amount of water pumped daily by the Calumet and Hecla to its mill is about thirty-four millions of gallons, a good supply for a city. But more than this, this company has nearly completed a pump that will throw about fifty millions of gallons a day, or an amount in excess of half the water supply of the great city of New York prior to July, 1890. The dividends this company has made to its stockholders exceed $35,000,000. It is only by such comparisons that the mind of the general reader is brought to a comprehension of these great works.—*New York Times.*

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CYLINDER CONDENSATION.

By G. H. Bodmer.

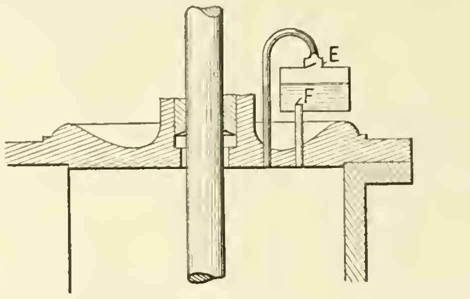
It seems at first sight almost incredible that, in engines working at a high speed, such a rapid transfer of heat from the working substance to the cylinder metal, and *vice versa*, as is implied by the condensation of a large percentage of the steam entering the cylinder at each stroke, should be possible. That it is possible, however, has been proved by ocular demonstration in the very neat and ingenious experiment of the late Gustav Hirn. This experiment consisted in placing on the cylinder cover a small vessel, which could be partially filled with water, and connected with the interior of the cylinder by two pipes, one from the bottom of the vessel and one from its top. Check valves were placed at the orifices of these pipes in the vessel, so that steam, on admission to the cylinder, opened the valve *F* at the bottom and passed into the water, the valve *E* at the top remaining closed. As expansion proceeded, the valve *E* opened and *F* closed, and it was found that water evaporated and escaped from the vessel. By making the vessel partially of glass the interior could be observed, and it was seen that at the commencement of each stroke the surface of the glass became instantly clouded by condensation of the steam admitted and cleared again, owing to re-evaporation when the exhaust took place. These phenomena were clearly visible both at low and at high speeds.

Under certain conditions, to which I shall subsequently refer, we may now take it as proved that, within certain limits, the initial condensation is proportional to the total mean range of temperature in the cylinder, and can proceed to consider the effect of other influences.

In the first place, among the latter is the speed. If the condensation of the steam on entering the cylinder, and its re-evaporation on the opening of the exhaust port, were nearly instantaneous, or so rapid as to be completed during a very small movement of the piston at either end of the stroke, the number of revolutions made by the engine could not affect the quantity of heat transferred from the steam to the metal, or *vice versa*. As a matter of experience the number of revolutions does influence the transfer of heat, and we are therefore forced to the conclusion that either condensation or re-evaporation, or both, are continued during a considerable proportion of the stroke.

It is quite conceivable that the re-evaporation during exhaust may take place throughout, say, one-half of the stroke, while the condensation previous to cut-off is limited to a tenth or less of the stroke. Under these circumstances the depth to which the metal is cooled depends on the speed of the piston, which determines the time allowed for the cooling action, the re-heating of the metal during the admission period being extremely rapid. There are reasons, which will be subsequently stated, for believing that this is what actually occurs, but from a practical point of view it is more important to ascertain, if possible, the laws according to which initial condensation varies with the speed, than to speculate on the cause of this variation.

What is the influence of the dimensions of the engine on initial condensation? It seems obvious that the condensation will be influenced chiefly, if not entirely, by the area of the metal surfaces exposed to the steam. As initial condensation all occurs previous to cut-off, only the area exposed to the steam before that point is reached can materially influence it. Both the experiments of Major English and Mr. Willans show that the variations in the exposed surface due to different degrees of expansion have practically very little or no effect on the initial condensation, and this points to the conclusion that the clearance surface only is concerned in producing initial condensation, which must therefore take place with extreme rapidity mainly at the very commencement of the stroke, when the velocity of the piston is relatively small. It is scarcely probable that this strictly represents the facts in detail, but as regards the broad results it is sufficiently true for practical purposes.



* * * It is not to be supposed that the cooling effect of every part of the clearance surface is equal, but there is no experimental evidence to show how this varies, and until such evidence is forthcoming we must be satisfied with average results. It has been recently suggested that initial condensation takes place chiefly on the surfaces of the steam ports, through which the steam flows at a very high speed, the conditions there being consequently exceptionally favorable to a rapid transfer of heat. Against this view it may be said that the more rapid the condensation the sooner it ceases, owing to the metal surfaces attaining a temperature near that of the steam, so that the result remains much the same whether the velocity of flow be high or low. The matter would be very different if the heat were dissipated outwards by conduction and radiation as quickly as it is transferred to the metal.

The amount of compression usually given in simple engines seems to have no appreciable effect on the initial condensation, although it must have a tendency to reduce the range of temperature through which the clearance surfaces are heated by the admission steam. This is no doubt due to the very short period over which compression extends.

The conclusions arrived at with regard to initial condensation may be summarized as follows:

Initial condensation is:

Proportional to the range of temperature in the cylinder.

Proportional to the area of the clearance surfaces.

Inversely proportional to some power of the number of strokes made in a given time.

Independent of the expansion ratio.

Independent of the density of the steam.

Dependent to some extent on the construction and material of the engine.—*Industries.*

◆

The authorities are justly severe upon lottery advertisements, and prohibit their being mailed. Why not take a little heed of other frauds which also use the mails to swindle the public, and exercise a little supervision over the clothing store swindles. The grossest frauds of the day are practiced in this trade.

TRIPLE-RIVETED, DOUBLE BUTT-STRAP BOILER JOINTS.

By John H. Cooper, M. E.

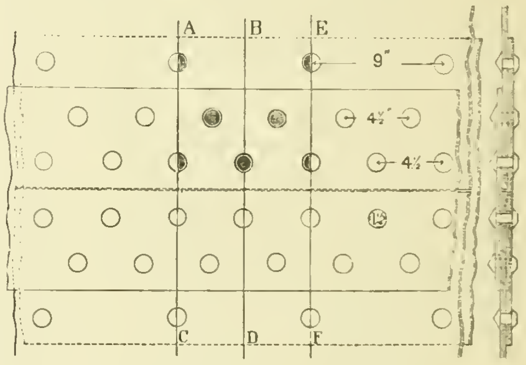
Some discussion having arisen regarding the proper method of computing the strength of a triple riveted butt-strap boiler joint, in accordance with the Philadelphia rule, an example of such a calculation will be interesting, and is here given. The Philadelphia law says that, in estimating the strength of the longitudinal riveted seams in boilers, the following two formulæ shall be appled:

Formula A.—From the pitch of the rivets subtract the diameter of the holes punched to receive the rivets, and divide the remainder by the pitch of the rivets. The result is the percentage of the strength of the net section of the sheet at the seam, as compared with the strength of the solid part of the same sheet.

Formula B.—Multiply the area of the hole filled by the rivet by the number of rows of rivets in the seam, and divide the product by the pitch of the rivets, multiplied by the thickness of the sheet. The result is the percentage of the strength of the rivets in the seam, as compared with the strength of the solid part of the sheet.

It is to be assumed that the boiler will fail by fracturing the plates or by shearing the rivets, according as plates or rivets are the weaker; so that in finding the working pressure we take the lowest of the percentages as found by formulæ A and B, and apply that percentage as the "value of the seam" in the following formula.

Formula C.—Multiply the thickness of the boiler plate, expressed in parts of an inch, by the "value of the seam" as obtained above, and again by the ultimate tensile strength of the metal in the plates. Divide the product by the internal radius of the boiler in inches, and by the desired factor of safety. The result is the pressure per square inch at which the safety-valve may be set.



(The factor of safety is 5, or, under certain conditions specified in the statute, it may be as low as 4.)

There is no difficulty in applying this rule to ordinary lap seams riveted with one, two or three rows of rivets, all of equal pitch; but in the case of a joint such as is mentioned above, in which some of the rivets are exposed to double shear and others only to single shear, and in which some have a wider pitch than others, it has sometimes been asked what interpretation should be put upon the rule. The accompanying example shows what the proper interpretation should be, in my opinion.

In the joint about to be considered, the arrangement of the parts is as in the cut. The pitch in the double-riveted part is $4\frac{1}{2}$ inches, the outer row of rivets being pitched 9 inches apart. The rivet holes are $1\frac{1}{4}$ inches in diameter, the shell of the boiler is 60 inches in diameter, the rivets are of iron, and the shell plates are of steel $\frac{3}{4}$ inch thick, and having an ultimate tensile strength of 55,000 lbs. per square inch. In order to get the relative area of section of the shell plates through the holes, pitched 9 inches apart, we have, in accordance with Formula *A*:

$$A=\frac{9-1.25}{9}=.861.$$

(It is not necessary to calculate this percentage across the other lines of rivet holes, since the joint could not fail by simple fracture along one of these lines unless both the straps broke; and since the two straps taken together are considerably stronger than the solid plate, it follows that no danger need be apprehended from this source.) The area of the 1¼ inch rivet hole being 1.227 sq. in., formula B gives us, as the rivet section in the holes of a 4½-inch section of the joint, the following:

$$B=\frac{1.227\times4.5}{4.5\times.75}=1.636.$$

I have taken the number of rivet sections exposed to shear as representing the number of rows of rivets required by the formula. Two rows of rivets, each through three plates, that is, through two outside plates with boiler shell plate between them, will present four sections of the rivets to shear in one unit, *A B C D*, of the joint, and the single row through two plates at 9-inch pitch must be counted as a half a rivet. The result would be the same if we were to take a 9-inch unit of the joint, as *A E C F*, and then include the actual number of rivet sections exposed to shear within this limit; we should then have 9 sections of rivets within 9 lineal inches of the joint, which would give the same result by the formula as 4½ sections in 4½ lineal inches of the joint. Either case fills the intention of the city rules.

We must next understand that formulæ A and B of the city rules do not determine the strength of anything; but they do consider the sectional areas of the two components of the joint, which may be taken to stand for relative strength when all the materials of the joint are homogeneous, having shearing and tensional strength the same; and we are to note that formula C also supposes the shearing and tensile strength of the rivets and plates to be exactly the same when they have equal areas exposed to the same strain. Therefore, if we admit a difference in strength of the rivets and plates that make up the joint in question, we must search for the exact figures of each before we can ascertain the true value of *B*.

We see by formula *B* that the rivet section is nearly double the plate section. Now we know that the city rules do not provide for a composite joint, and therefore, as the steel plates of which this boiler is composed are known to be stronger than the iron rivets which hold them together, it is proper that the rivet section should be proportionately greater than the net section of the perforated plates; but how much greater is a matter of many opinions and of diverse results of experiments. If we accept Chief Engineer Shock's experiments on bolts of iron subjected to single and double shear, we may take from his tables 40,700 lbs. per square inch, for single shear, and 75,300 lbs. per square inch for double shear, which numbers represent the shear, pure and simple, and do not include the uncertain element of friction.

With these figures before us (which are among the lowest on record), we are prepared to find the true value of *B*, thus:

The double shear of two rivets, per square inch, = 150,600 lbs.
The single shear of a half rivet, per square inch, = 20,350 lbs.
The sum of which equals........... 170,950 lbs.

Opposed to this is a corresponding section of the plate, in a unit of the joint, *A B C D;* 55,000 lbs per square inch, multiplied by 4½ inches, the length of this unit, equals, 247,500 lbs.

The two results just obtained must be placed in formula *B* in order to give the weaker material the proper additional area of section, thus:

$$B=\frac{1.227\times4.5\times170,950}{4.5\times.75\times247,500}=1.13$$

We see by this result that the effective rivet section is far beyond the requirement of the plates, and might safely be renduced.

Proceeding now according to city rule we must take the least of the two results found by formula *A* and *B* and insert it in formula *C*, thus;

$$C=\frac{.75\times.861\times55,000}{30\times5}=237\text{ lbs},$$

This result may be accepted as the working pressure allowed in this boiler; for it is accordance with the spirit of the city rule, although it embodies elements that do not lie within the limits of the ordinance.

◆

REPORTS OF ENGINE PERFORMANCE.

COMMENTING upon the regulation report of steam engine performance, the *London Engineer* says that they have come to mean little or nothing of practical value to engineers and engine builders. To wit:

When a maker of steam engines produces something which he believes to be exceptionally good, he very naturally gets a report made by some independent authority, and uses that report as a means of bringing his firm before the world. This is legitimate and proper. Such a report tells a mill owner whether his engines are or are not working to the best advantage. This also is a legitimate and proper reason for obtaining a report Both objects are, however, narrow in their scope; they represent limited interests. The third and last object is purely scientific. For the purposes of the steam engine maker or the mill owner, the preparation of elaborate tables is entirely unnecessary. It is only when we come to deal with the thermo-dynamics of the steam engine that great elaboration is demanded.

Alluding to a special report, our contemporay says:

"We are then left with the question, What does this really admirable and complete report teach? What has it added to the existing store of information? There can, we are sorry to say, be but one answer—nothing. After reading it, and digesting it, and thinking it over, we are no wiser than we were before. We do not know, and Mr. Longridge does not know, why one of these engines used more steam than another per horse-power per hour any better than we did before the trials were made. They confirm nothing; they originate nothing; they add a great mass of figures to the mighty heap of such things that already exist. Mr. Longridge himself can do little with his facts. They leave him just where he was. Here, for example, are the deductions in his own words concerning the first engine on the list, namely, the compound receiver engine.

"The consumption of steam per i.h.p., and the percentages of water present in the small cylinder are unusually high, especially without the steam jacket. The cause may have been condensation in the steam main, producing a large percentage of moisture in the steam supplied to the cylinder. If the 19.56 lbs. of steam used per i.h.p. per hour on the 20th February contained 10 per cent. of water, the mixture would only contain the same quantity of heat as 18.09 lbs. of dry saturated steam, while the equivalent of 18.1 lbs. of the same mixture on the 21st would only be 16.74 lbs. The jacketing of the barrel of the small cylinder, and of the internal surface of the annular receiver, seems to reduce the rate of consumption by about 7½ per cent., notwithstanding the inadequate diameter of the steam supply pipes. If these pipes had been larger, and the cylinder ends jacketed, as well as the barrel, the saving effected by the jacket might have been greater still."

No attempt is made to say positively why the engine was not more economical. The cause "may" have been this; it "might" have been that. The reason for this vagueness of statement is sufficiently obvious. Mr. Longridge does not know why the engine did not use less steam. The experiment supplied no information on the subject. He can only surmise. It is the same with the other two engines. As regards the second, it is worth while to quote Mr. Longridge once more: "The only remarkable point about these trials is the increase in the rate of consumption of steam attending the use of the jackets. The increase is very little more than 1 per cent., and may be attributable to errors of observation. On the other hand, it may be an actual fact, to be explained by the small diameter of the jacket steam pipes. If these pipes could not discharge sufficient steam to keep the pressure in the jackets as high as the initial pressure on the pistons, the jackets may have abstracted instead of supplying heat during the admission, and thus increased the initial condensation in the cylinders." Here again "if" is the dominant note sounded by Mr. Longridge. That which is wanted from a scientific investigation of this kind is definite information as to the nature of the defects present in an engine, and suggestions as to the means of avoiding them in future engines. In a word, such reports should be guides to practice. This report, as it stands, like nearly all reports of the kind, leaves us quite in the dark on almost every conceivable point as to what to do and what to leave undone in preparing designs for other engines. It may perhaps be urged that a report of the kind cannot possibly supply the species of information needed. This may be quite true, but if true, then it is certain that the multiplication of data it a mere weariness to the flesh.

[This is in accordance with many views we have expressed on the same subject, and we think most practical engineers will agree with the sentiments expressed.—EDS. ENGINEER, N. Y.]

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◆

AFTER the great dam across the Housatonic River was built, several years ago, the people of Birmingham, Ct., and of Shelton across the river, were bothered by the frequent shaking of their houses, which at times became a positive nuisance; windows would rattle, doors shake, pictures swing to and fro, and in the winter, when the ground was frozen, crockery in the closets would rattle. Large plate-glass fronts in the stores have been mysteriously cracked and broken, the cause being attributed to the concussion of the atmosphere from the immense body of water flowing over the dam. Early last spring the flash boards were removed from the dam, but the iron rods to which they were affixed were left in place. Immediately the jarring and rumbling ceased. It was thought that these rods broke the big sheet of water, so as to allow the air to escape from under the fall, and the accidental discovery was hailed with gladness by a wearied people. It seems now that this theory is all wrong. The old trouble has been resumed. The iron braces are yet in position, and the flash boards have not yet been put up. The conditions are just the same as at the time when the noise ceased last spring. At that time a number of scientific men examined the dam, and came to the conclusion that a valuable discovery had been made by accident. Now they have to evolve new theories and suggest new remedies to obviate the trouble.

◆

MUCH has been said concerning the marked falling off in speed at the trial of the dynamite cruiser '*Vesuvius*' at Newport two weeks ago. The speed in May was 21.64 knots an hour, but at Newport it was only 20 knots. The officers say that two circumstances must be taken into consideration before a condemnation is uttered against the screw propellers. One is, that at the trial in May, which was the official one of the contractors, the displacement of the vessel was only about 800 tons, and now it is about 1,000 tons. In other words, she was not in full sea trim when she made her first official trial. Then, too, her bottom at the Newport trial was very much fouled, which materially retarded the speed. It is not certain that the screws of coarser pitch, recently put on, will be taken off, but her bottom will be cleaned, and she will be given another trial. The object of putting on the screws of coarser pitch was to get greater speed at a less number of revolutions than with the screws of finer pitch, the latter making 270 revolutions a minute, a speed which made it impossible to keep the engines properly lubricated.—*N. Y. Sun.*

[It is possible to lubricate engines at 600 revolutions per minute.]

◆

JOHN KITCHEN, who was for sixteen years in charge of the old '*Adriatic's*' engine room, and who was promoted to the White Star steamer '*Brittanic's*' engines in August, 1886, has a record of which he is justly proud. He has made one hundred and fifty-four round trips between Liverpool and New York, nearly a million nautical miles, without once disabling his engines.

◆

NITRATE of soda has a strong attraction for water, absorbing so much of it from the air as to be dissolved by it in large quantities when in bulk,

TRADE NOTES.

THE Consolidated Ice Machine Company, of Chicago and New York, failed lately, with liabilities of $350,000 and assets of $1,000,000, including $828,000 in outstanding accounts.

⁂

THE Curtis Regulator Company, of Boston, Mass., have issued a new catalogue of their engineer's specialties, reducing valves, steam traps, water pressure regulators, damper regulators, etc., which they will send upon application.

⁂

THE '*Mackinaw*,' a large steel vessel of 2,578 tons, was built at West Bay City, Mich., taken to Buffalo, and cut in two to enable her to pass through the St. Lawrence Canal, and from thence taken to Montreal, where she was rebuilt and came to this city. She is to run in the coast trade.

⁂

THE Globe Iron Works, of Cleveland, Ohio, will build two 300 feet steel steamers for the Goodrich Transportation Company. These steamers will be propelled by twin screws driven by separate triple expansion engines, the steam for which will be furnished by a battery of six Scotch type boilers.

⁂

ABOUT six months ago the Illinois Steel Company entered into an arrangement with its men on a profit-sharing basis, and three months later divided about $4,000 among them as premiums for faithful and efficient service. Another quarter has passed, and they will this week distribute another $4,000.

⁂

THE Pennsylvania Railroad Company announces the construction of a second double decker ferryboat, the hull of which is to be entirely of iron. The new boat will cost $150,000. It will be a screw propeller. Its length over guards will be 206 feet, beam over guards 65 feet, and depth from base line to top of deck beams 17½ feet. Electric lighting will be used.

⁂

THE Navy Department has adopted an improved torpedo net, which will be supplied to all the armorclads. This net is an American invention, and, as it has not been patented at home or abroad, the officials are not at liberty to give information concerning it. It is said to possess many advantages over the French net now in general use in European navies. It is to be manufactured at some place in the United States.

⁂

A RECENT patent provides for the prolongation of life of arc light carbons. The invention consists in the application near the arc of a protective shield which prevents the rapid consumption of carbon, the tip being fed as the carbon wears away. The theory of the action of this device is not yet clearly defined, but its inventor is of opinion that, while the protective shield may prevent the dissipation and loss in the air of any unconsumed carbon partic es, it may, on the other hand, cause the complete combustion of such particles by concentrating them on the arc. In actual practice it is found that the shield decreases the consumption by quite one-half, and that carbons burn twice as long as they ordinarily would without any decrease of candle power.

⁂

JUDGE GRESHAM, of the Federal Court, decided, on October 25, the suit of Walker & Otis, of Terre Haute, charging infringement of patent in the use of the Bragg fire alarm device. The invention consists of a gong and a contrivance that unfastens the halters of the horses and drops ths harness upon them by electricity when an alarm is sounded. Several years ago the plaintiffs purchased the right to make and use the device in a number of States, and sought to introduce it into a number of fire departments. The owners then discovered that, without authority from the patentee, the device was used by nearly every city in the Union having a paid fire department. Suit was entered in 1887 to enjoin the city of Terre Haute and to recover damages, and Judge Gresham to-day decided in favor of the plaintiffs. Suits will now be filed against every city in which the invention is used.

⁂

BRITISH agents in the United States and Canada are reported to be negotiating for an immediate supply of nickel ore for the use of the British Navy. This is a direct outcome of the recent Annapolis test, and it is said that the British Admiralty proposes to strip as rapidly as possible all war ships now in English ports having compound armor. This will involve an enormous outlay of money. It is said that Cammell & Co. will immediately begin the rolling of nickel-steel plates. Notwithstanding Secretary Tracy s energetic measures in securing an appropriation of $1,000.000 for nickel, it is recognized that already the British Admiralty is abreast with the United States Navy Department in the race for metal. The British have the advantage in possessing establishments ready to undertake at once the rolling of plates. Plates for the new American war ships cannot be turned out much inside of a year.

⁂

SECRETARY TRACY has taken an important step in increasing the corps of naval constructors by ordering five young men abroad for a course of special instruction in naval architecture, preparatory to appointment as Assistant Naval Constructors. Another will be ordered abroad in a few days, making six in all. Those who received orders are Ensigns Robert Stockes, Elliott Snow, and Naval Cadet R. P. Hobson, who will attend the *Ecole d'Application Maritime*, at Paris. and Naval Cadets T. F. Ruhm and George H. Rock, who will go to the University of Glasgow. The course of study at both these institutions is three years, and embraces shipbuilding in all its branches. The Government has four young officers abroad at present—Assistant Naval Constructors L. Lloyd Bankson and George W. Street, at the *Ecole d'Application Maritime*; and Assistant Constructors John Tawresey and William Van Zandt at the Royal Naval College, Greenwich. These officers are all to be ordered home at an early day and assigned to active duty in the construction corps.

⁂

IN the Supreme Court, Brooklyn, Judge Cullen has rendered a decision that will interest business men everywhere. Enoch Rutzler and George W. Blake had been for five years partners in the steam heating business on Centre Street, New York. The co-partnership was recently dissolved, and Blake started in the same business in Wooster Street. He then moved to enjoin Rutzler from continuing the business at the old stand, or anywhere else in New York, in connection with the firm name. Judge Cullen lays down the law as follows: "The authorities are plain that in the dissolution of partnership or the sale of a business with its good will, in the absence of any covenant to the contrary, either partner or vender may prosecute the same business at any location, even next door to the premises occupied by the firm. In such cases the good will amounts to nothing more than the probability of the customers resorting to trade at the old stand. Defendant Rutzler, therefore, has the right to carry on his business at the premises he has hired for that purpose." The court goes on to explain that Rutzler may not describe himself as the successor of the late firm, nor put out any sign or publish any advertisement calculated to mislead the public to believe that he is the successor, or is continuing the business of the old concern. He may, however, describe himself as "lately a partner in the firm," or as being "formerly with it."

["In the absence of any covenant to the contrary" should be particularly noted in the above.]

⁂

F. N. ATWOOD, of Chicago, has invented an air ship which he claims will be able to travel seventy miles an hour. A company with $200,000 has been organized to build it. The principles he has patented differs from all others yet invented. The ship is cigar-shaped, and has a big cabin under it. Huge tanks are to contain hydrogen gas. which is to be partially used in lifting the ship from the ground. Three engines are inside the cabin operating seven fan wheels. Three of them are propellers. One is under the bow and one under the stern, arranged so that they can turn any way, like a rudder. Four wheels are to be used in elevating the ship. These are 12 feet in diameter and revolve in cylinders that open out of the bottom of the ship. The idea is to run these wheels 1,000 revolutions a minute and thus force a column of air out of the cylinders, creating a vacuum. The air rushing back toward the open cylinder will elevate the ship (?) Each wheel, the inventor estimates, has a lifting power of four tons. The ship itself will weigh but 25,000 or 30,000 pounds, and with four wheels, each having the power to lift four tons and with the auxiliary assistance of the hydrogen gas, Mr. Atwood thinks he can lift his ship. Once elevated, it is an easy thing to propel it. The ship will be built of aluminium, and will be 305 feet long, 50 feet high, and 50 feet wide. The hydrogen gas will be manufactured on board the ship. Steam will be the motive power and gas the fuel. The engines are strong and light and specially construed. The ship will cost about $30,000, and will be built immediately.

(And will fail immediately.)

A WRITER in the *Locomotive Engineer* who signs himself "Supt. of Machinery," says:

> "Our friend seems to differ with me on setting a valve and squaring one. I call squaring one getting your valve yoke to fit your valve so that it will be square at both ends of steam port, getting your links plumb and hangers the same, and proper length, also arms on tumbling shaft proper length, and reach rod the proper length."

In this part of the world squaring a slide valve is to make it open both ports equally.

THE lawyers and the courts and the railroads have their art down to such a fine point that in a recent case in Indiana it was decided that a passenger who was looking under a seat for some money he had dropped, and who was on his knees when a collision came, and suffered a broken arm, was guilty of contributory negligence.—*Detroit Free Press.*

SEND for our Cash-to-Canvassers circular.

THE recipes for various purposes going the rounds of the technical press ought to be retired without pensions. They are all older than the Pyramids and have been worn out by constant use. Some of our contemporaries think so highly of these as useful matter to their subscribers that they publish them regularly six or seven times a year.

THIS originated in a western paper, which is by no means the *Eatanswill Gazette:*

> "The item is as nearly correct as any other news which originates in the mouldy and cob-webbed office of our antique friend, and quite as reliable as anything else ever written by the moon-faced fossil who sleeps over its shears and paste-pot."

We thought this style of journalism was effete, as one might say!

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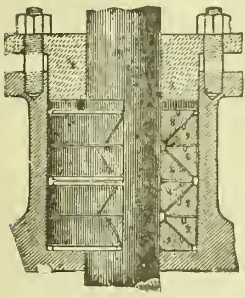

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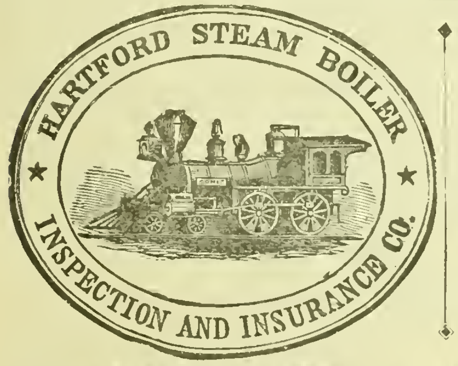

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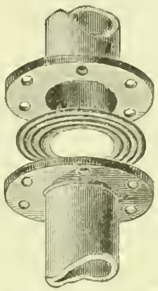

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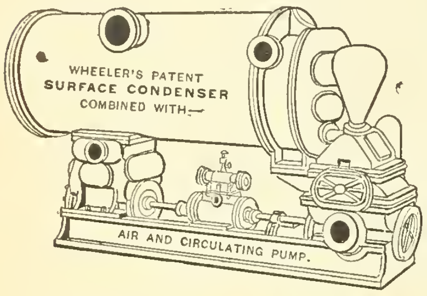

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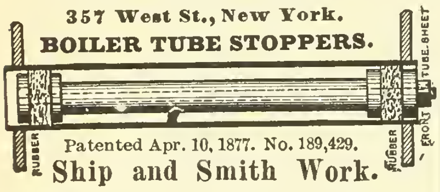

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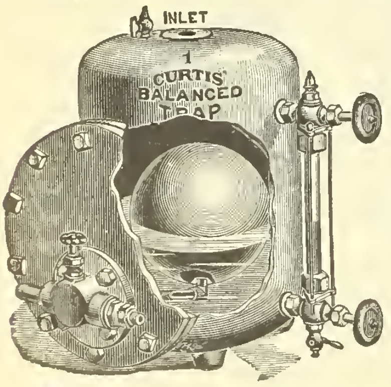

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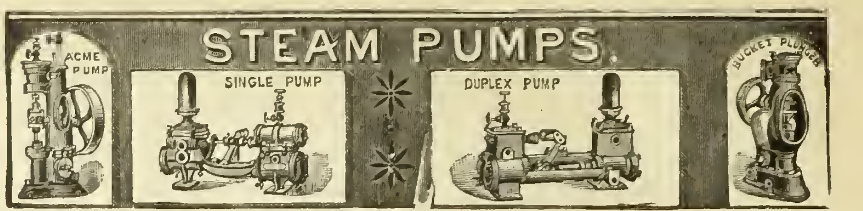

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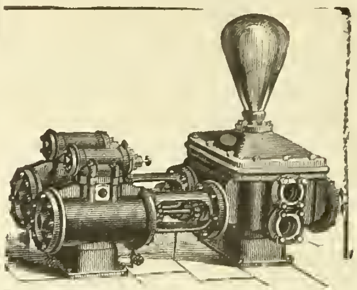

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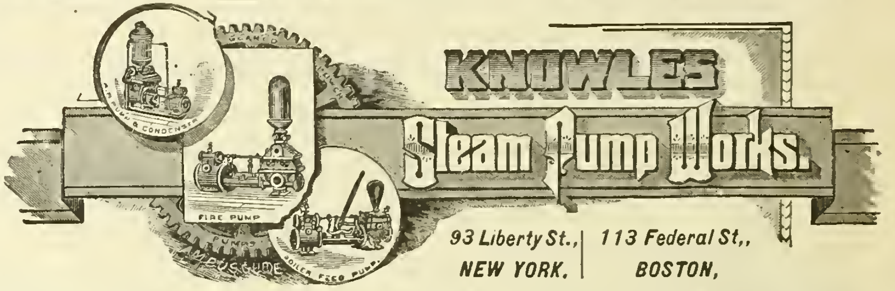

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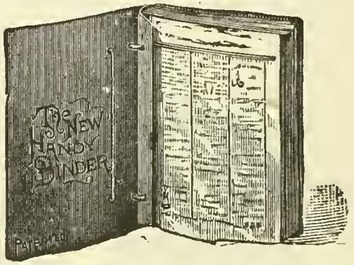

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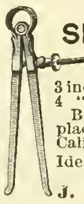

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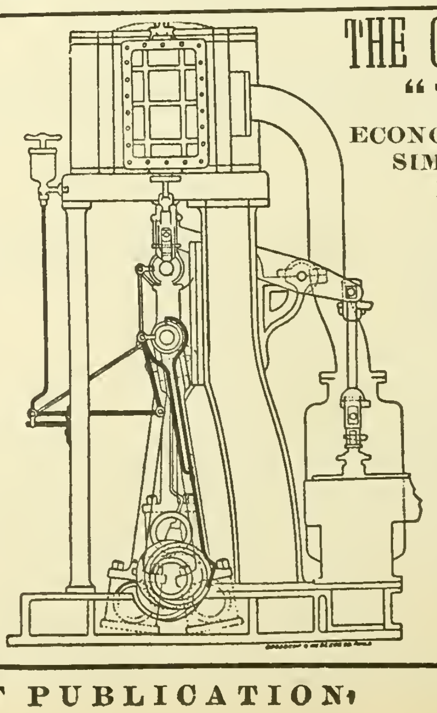

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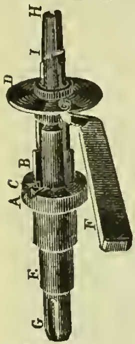

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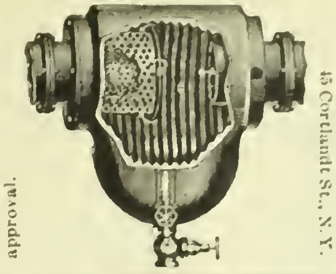

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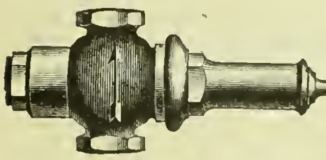

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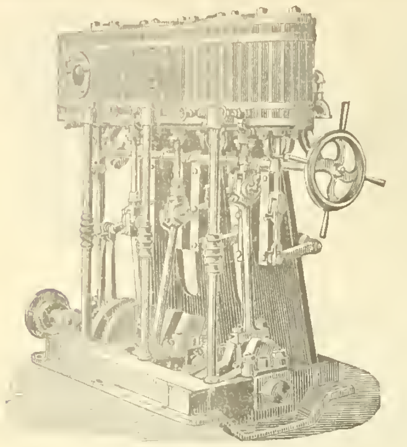

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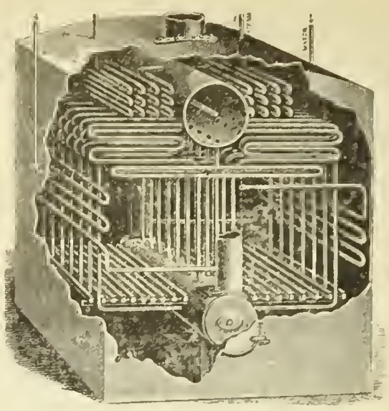

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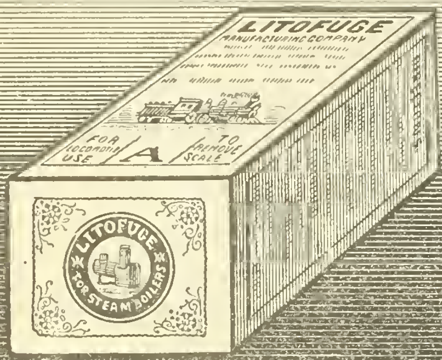

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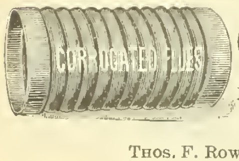

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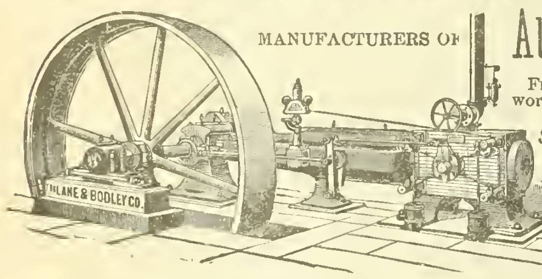
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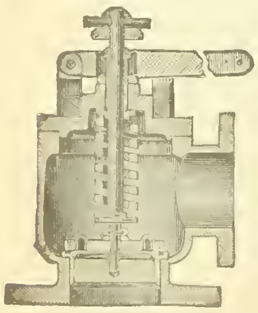

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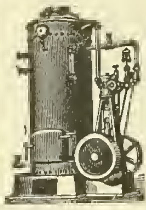

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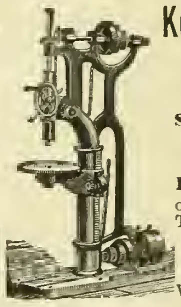

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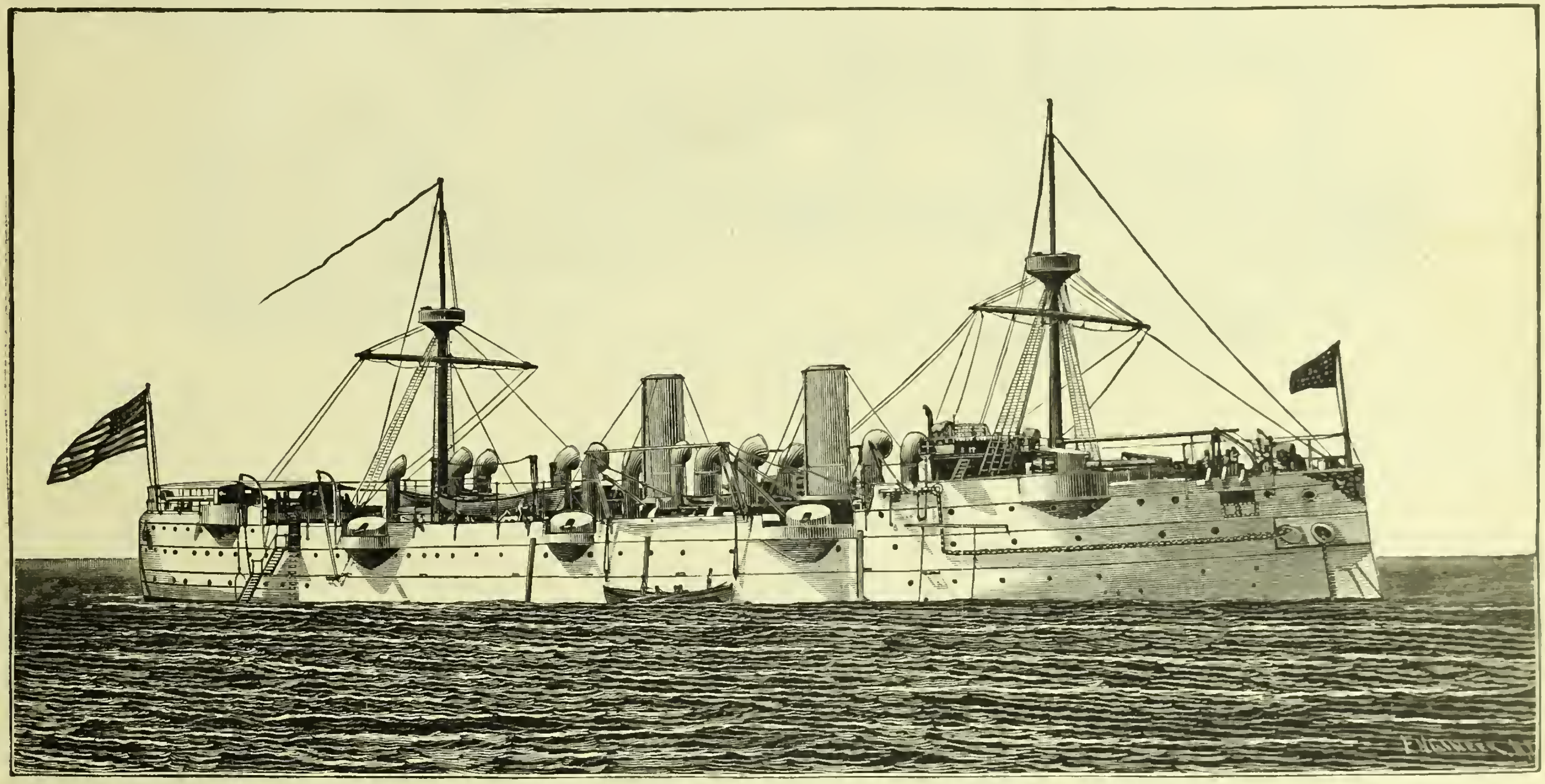
THE NEW NAVY. No. 2.

THE 'BALTIMORE,' U. S. N. CRUISER.

OUR engraving in this issue represents the new steel cruiser '*Baltimore*,' and is an exact reproduction of her as she lies at anchor, from an instantaneous photograph. The '*Baltimore*' is a twin-screw steel cruiser, with a heavy protective steel deck. She is 335′ long over all, 48′ 6″ beam, and has a mean draught of 19′ 6″; her displacement is 4,400 tons. Her indicated horse-power with natural draught is 7,500, with forced draught 10,750. She has two sets of horizontal triple-cylinder expansion engines from designs by Horace See, an American civilian engineer, in water-tight compartments, the cylinders being $\frac{42'',\ 60'',\ 94'',}{42'',}$ driving two three-blade screws 14′ 6″ diameter. These are driven by four double-end horizontal return tubular boilers, 14′ 6″ diameter, with four corrugated furnaces in each end. The ship and her machinery was built by William Cramp & Sons, Philadelphia, and upon the trial run developed 19.6 knots per hour, for four consecutive hours. The '*Baltimore*' is one of the handsomest vessels in the new navy. and is as capable and seaworthy as she is handsome.

She was selected by the Government to convey the remains of John Ericsson to his native land, and upon her return from that duty Capt. Schley, commanding the '*Baltitimore*,' reported to the Navy Department from Lisbon, Portugal, October 22, that he made the passage from Copenhagen to Lisbon in five days five hours. The ship encountered heavy gales and behaved admirably, showing seagoing qualities of a high order. She maintained a high speed, varying from fourteen and one-half to sixteen knots an hour without difficulty or risk, in heavy seas, for two consecutive days, giving conclusive proof that no mistake had been made in the calculation of her weights. Capt. Schley says that he never has sailed in a ship having so much stability and ease of movement in a heavy gale. Her greatest roll was thirty degrees, and was so easily made and recovered from that but ordinary inconvenience was felt. There was no time during the gale when her battery could not have been fought. After passing through the English Channel the steam power was reduced one half, and using forty-five tons of coal a day, including cooking, distilling water, and dynamo consumption, she maintained an eleven-knot speed without trouble.



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LUDWIG MOND, who introduced the Solvay process for making soda, burns coal with artificial draught, and, conveying the gases into a chamber, washes them with water spray, which causes every particle of soot or smoke to be deposited; at the same time he condenses and recovers the ammonia (a product of the nitrogen of the atmosphere which passes through the fire), as well as the sulphurous fumes. To get an equal efficiency of steam-raising power, he has to burn 125 tons of coal in place of 100 tons, and for every 125 tons of coal burned he recovers four tons of sulphate of ammonia. The fuel, if cheap, (say $1.25 a ton), will cost $155, and the sulphate of ammonia, at $60 a ton, is worth $240. The late Sir William Siemens showed that if coal were freed from its by-products, it would be better as a fuel, and the by-products themselves would be worth twice as much as the original cost of the coal.

◆

THE article on "*Triple Riveted Butt Straps*," in the last issue, should have been credited to *The Locomotive* of Hartford, Conn.

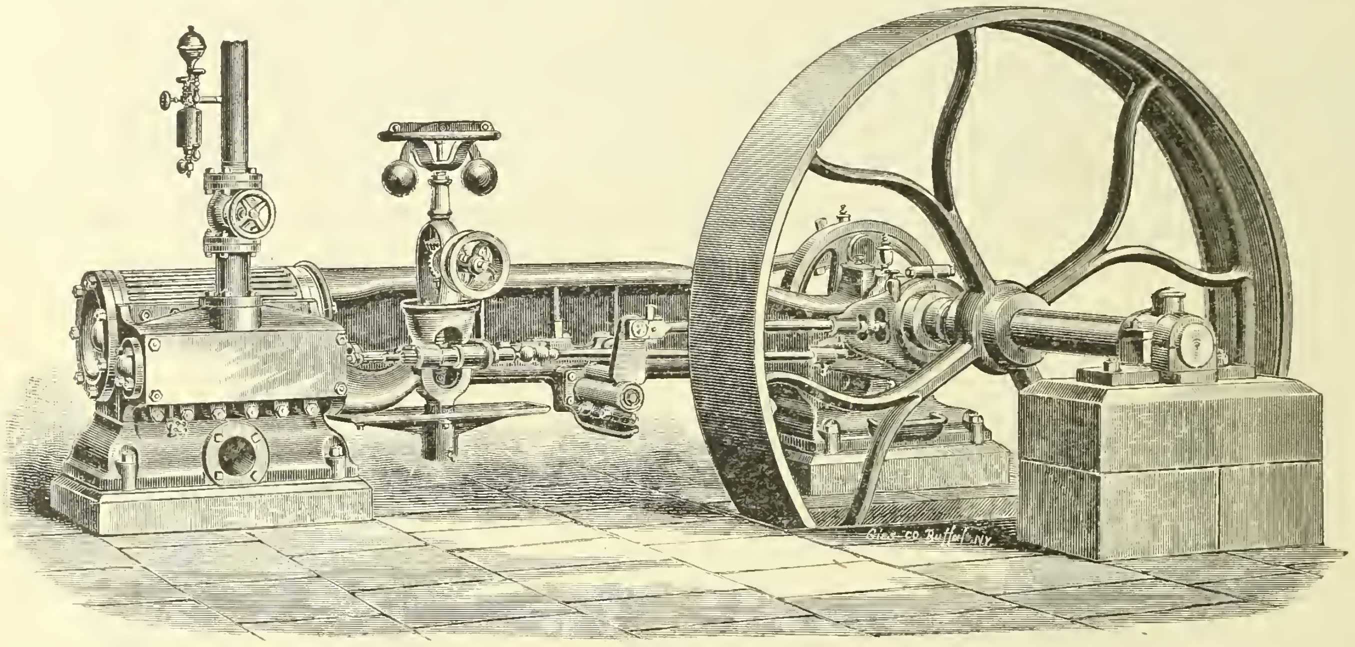
IN all parts of the Amazon Valley may be seen numbers of steam launches of from ten to fifty tons burden, which are used by the local merchants to collect rubber from the camps and bring it to the towns for shipment to Para. These boats are, almost without exception, built in England and France, and each year the demand for them increases. There is no reason why Americans should not furnish the bulk of such vessels in Brazil and Eastern Peru, if they would build them of proper designs, and seek for orders. The prevailing type has an iron hull, standing high out of water, from twenty-five to forty feet in length, and has a flush deck, except for a small cabin aft, and the casing of the engine hatch, the whole being covered with a thin wooden or iron canopy. They are propelled by a screw, driven by an upright engine, and provided with boilers adapted to the burning wood, and have a draught of from 3½ to 6 feet. As long as the English control the navigation of the Amazon, they will, of course, build their own steamers, but the launches are ordered by merchants, who are simply looking for the best they can get for their money, so that this field, which is a fertile one, is open to competition by our manufacturers. —*American Manufacturer*.

◆

WHEN you see statements made in reports of engine trials that the speed of steam is a certain number of feet per minute at a certain pressure, you can believe or disbelieve the statements, as best suits your temperament. The velocity of steam is dependent (we say) upon the condition of the surfaces it passes over, the temperature of them and the temperature of the steam, so that various velocities may be had—dependent upon the conditions—for the same pressure and temperature.

THE WOODBURY MEDIUM SPEED AUTOMATIC ENGINE.

The illustration shows a medium speed automatic engine, as built by the Woodbury Engine Company, Rochester, New York. Aside from its design, a feature of importance is the character of the workmanship and the material employed. The Woodbury Engine Company is one of the oldest in the country. It was started in 1851 by D. A. Woodbury & Co., and from that date to the present time has been building boilers and engines for all sorts of purposes.



In the engine shown no labor or expense has been spared to produce a machine which will give satisfaction in all lines of work, whether for electric lighting or general manufacturing. It is, as its name implies, an automatic cut-off engine, regulating itself, so to speak, to the work required of it. As this duty devolves directly upon the valve-gear and the mechanism which controls it, it is of interest to see how it is accomplished. The main steam valve is of the long D type, which gives short steam ports and small clearances ; upon the back of it is carried the cut-off valve. This last is connected directly to the governor by suitable mechanism, and as the cut-off valve is a cylindrical slide, covering diagonal ports directly opposite, it is wholly balanced, and a very slight change of the valve effects a great change in the distance steam follows the piston. The cut-off valve stem is connected to a slide which works through a bracket, and the slide, is connected to the eccentric rod by a ball and socket joint, by which means the valve may be rotated on its seat in either direction by the governor, thus changing the point of cut-off to meet the requirements of load and steam pressure. The rotation, which never exceeds one quarter of a revolution of the valve, is effected by a segment on the cut-off valve slide engaging with a rack attached to the governor spindle, a construction that places the cut-off under complete control of the governor at all parts of the stroke.

If, in course of time, any leakage takes place past the cut-off valve, it does not go into the exhaust, as in some types of engines, but passes through the main valve ports into the cylinder, and is there utilized. Attention is called to the fact that there are but two valves, each one single piece of casting, and these, (with the fastenings of the rods), constitute all the valve mechanism inside of the steam chest; the other parts are outside and always accessible. Another feature of this engine is a patent cross-head and crank-pin. The cross-head pin is conical at each end, and is drawn tightly into place in the body of cross-head by a nut on the outside. Both ends are carefully fitted to bear equally, and the pin can be removed any number of times and will always fit; there is a hole in the frame through which the pin may be drawn at will. The pin is flattened at top and bottom, and the boxes are recessed out to correspond, so as to wipe over the edges or corners without wearing a shoulder, the cross-head itself being so designed that the center of pin is practically in the center of supports Springing of the piston rod due to angular thrust of connecting rod is entirely avoided.

The crank-pin is pressed into the crank-wheel with sufficient pressure, and with such accurate fitting as to require no bolting, riveting over, or other additional means of holding it securely in place. It is bored out in the center to form a chamber, the object of which is to provide a receptacle for a lubricating grease. So long as the pin runs cool the grease remains inert, but should the pin begin to heat (through stoppage of oil cup by dirt or neglect to fill oil cup), the grease will liquefy and run upon the surface of pin, thus lubricating the working parts. This provision (it is hardly necessary to say) is not intended for a steady means of lubrication, buts acts as an auxiliary in an emergency. We consider this recess of considerable value, as it takes a crank-pin but a short time to heat when its supply of oil fails, and a hot crank-pin means several hours shut down. The cavity can readily be filled by unscrewing cap. Price lists will be furnished by addressing The Woodbury Engine Co., Rochester, N. Y.

◆

Mr Maxim, the inventor of the "Maxim guns," claims to have constructed an engine of 500 h.p., weighing only 1,100 lbs., or 2 2 lbs. of dead weight to each horse-power, and if so he will fly without doubt This last statement is incredible, and we will add, unnecessary, because, if Mr. Maxim can construct an engine that will weigh 10 lbs to a horse-power, he may soar away at pleasure. We believe the best or highest result in constructing steam engines of large size is to develop a horse power for each 112 lbs. dead weight, including water. The matter is noticed in The Engineer, New York, and Mr. Watson has strangely forgotten to comment upon it.—*Industries, San Francisco.*

[The last few lines of this paragraph caused a roar in this office that was like the bursting of a dynamite cartridge! A very profane man hauled (or attempted to) a cart load of sand up a steep hill. At the top he discovered that he had forgotten to put in the tail-board. The bystanders expected an outburst, but the profane man was dumb.

"Why don't you swear?" said one.

"It's no use," said the man, "I can't do the subject justice."

That is why we do not comment always. Something should be left to the imagination]

◆

A great many circulars to canvassers have been sent out, and we want all who think it worth their while, to canvass their precinct. No canvasser is entitled to cash payments unless he complies with our terms in circular.

STEAM ENGINES FOR FLYING MACHINES.

Thus as to steam engines: Ordinary stationary engines weigh with their boilers from 500 to 1,600 lbs. per h.p.; locomotives, from 200 to 300 lbs.; marine engines for Atlantic steamers, 480 lbs.; and light launch engines—those of Herreshoff, for instance—some 60 lbs. per h.p. For aeronautical purposes, however, a steam engine was built by Stringfellow, which weighed but 13 lbs. and exerted 1 h.p., and another was built by Moy and Schill, of 3 h.p., and 80 lbs. weight, thus being about 27 lbs. per h.p.

But these weights, while including the boiler, do not include the water and fuel. These supplies may be estimated at 22 lbs. of water and 4 lbs. of coal per hour, so that if a large engine can be built as light per h.p. (13 lbs.) as that of Stringfellow, it would still need, if for so short a trip as two hours, 52 lbs. of supplies per h p , making a total of 65 lbs , including the engine itself.

The principal weight is that of water. It has been proposed to utilize part of this over and over again, equipping navigable balloons with surface air condensers, but the difficulties in the way of this, chiefly from the added weight, are almost insuperable.

Gas and petroleum engines suggest themselves. As now made they are excessively heavy, weighing from 280 to 1,000 lbs. or even more per h. p., so that the advantages of dispensing with the boiler and its water supply are completely lost. They are comparatively of recent invention, however, and it is believed that corresponding reductions of their weight can be made, such as have been effected for the steam engine, and that this is a promising field for experiment; for even if aerial navigation be never realized, improvements which will permit a reduction in the weight of gas engines are likely to cheapen their cost materially, and to extend their use, as well as the profits of their builder.—*O. Chanute.*

◆

In the shop where I am to-day there are no "rules," and absolute harmony prevails. Once in a while some worthless, noisy, careless chap gets a job, but he soon drops out, and goes where he can be "ruled," and spend his time scheming how to beat the boss, while probably the boss is figuring the same way to cheat his man. There is a sort of attraction between them. No, we don't need any rules, except the golden one.—*American Machinist.*

◆

One can scarce read a newspaper at the present day without finding account of some marvelous invention that calls for a suspension of proved natural laws. Also commercial schemes that violate all the proved laws of economics. We have yet some centuries of blind faith before us. The old trait of superstition will require much bruising before it ceases to bedevil humanity.—*Industries.*

Speaking generally of the application of aluminium to the manufacture of iron and steel, the usual amount stated to be requisite for producing good results is about .10 per cent.; but in many cases, as already pointed out, this would be too little. Supposing, however, that an average percentage of .10 per cent. or .15 per cent. was necessary, and assuming the aluminium to be sold at 8s. ($2.00) per lb., the expense of such addition would mean an extra cost of 18s. and 27s. per ton respectively, whereas, if as much as even .50 per cent. of silicon is required to do the same work, it does not cost more than 4s. 6d. per ton. On a large output of steel castings this means a serious difference, and in the above nothing is credited to the latter method by the gain of adding so much ferro-alloy, which afterwards counts as steel. If aluminium can eventually be brought to compete in price with existing alloys, there is a probability of something being done in introducing its use on a larger scale. Aluminium may find a use for certain special purposes, such as in higher carbon-steel, where silicon does not seem to act so powerfully in producing soundness as in the case of milder steel with carbon .50 per cent. and under. Therefore, whilst for some special purposes aluminium may be employed in the manufacture of iron, at any rate with our present knowledge of its properties, this use cannot be large, especially when taking into consideration the fact of its comparatively high price. Its special advantage seems to be that it combines in itself the advantages of both silicon and manganese; but so long as alloys containing these metals are so cheap and aluminium dear, its extensive use seems hardly probable.—*Industries* (*England*.)

◆

Plate glass is ground by means of wooden plates covered with iron, between which quartz sand abundantly moistened with water is used. By constant moving to and fro of the grinding plate over the plate to be ground, the quartz sand becomes mixed with particles of iron and sand, and after it has lost its sharpness is piled up near the manufactory as worthless. This sand contains about 15 per cent. of glass particles and 2 per cent. of iron particles. It is very hygroscopic, and before it can be used for the manufacture of bricks, has to be dried, and is then pressed into the mold under a pressure of 660 pounds per 0.155 square inch The pieces thus obtained are subjected to a temperature of 2732° F. At this high temperature the glass enters into a combination with the sand, a new product with new properties being thereby obtained. The bricks thus produced have a specific gravity of only 1.5; they are perfectly white and are not attacked by acids, and for this reason would be especially desirable for use in factories of chemical products, particularly in factories of sulphuric acid. They also resist frost. Regarding the strength of the material, experiments have shown them to posssss a compressive strength of from 840 to 975 pounds per 0.155 square inch. By mixing the sand, enameled bricks showing beautiful colors are obtained, which may be used for decorating fronts and interiors.—*The Brickmaker*.

◆

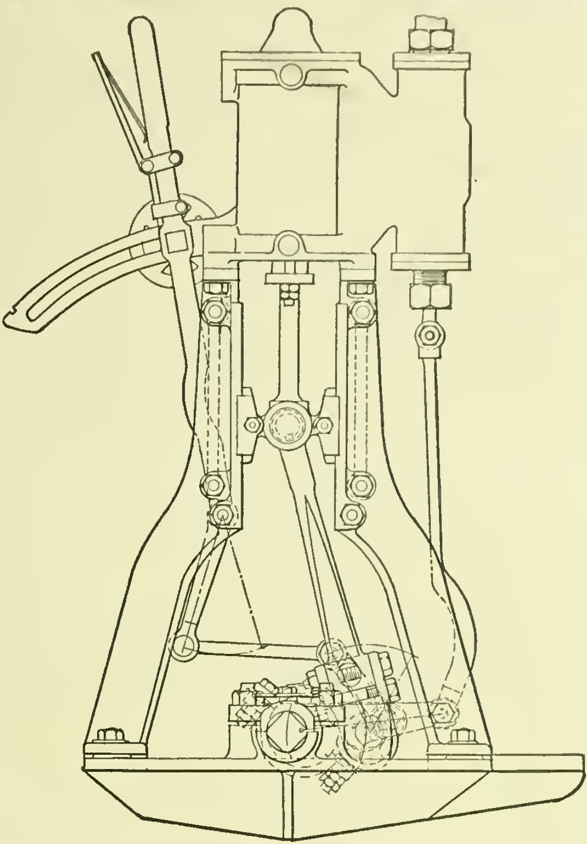
The daily paper engineers, who write up faked reports of maniac engineers running away with locomotive engines, are still practicing their nefarious arts. One of these geniuses recently made a fireman—at the command of the maniac engineer—run the steam up to 190, and a little later on to 250 lbs., while going at 60 miles an hour only, and he kept putting the fire out with green coal too, for the maniac engineer sung out (like a parrot) every minute, more coal! more coal! If the reporters would only tell firemen how to get 190 lbs. and keep it, to say nothing of 250 lbs., they would confer a favor upon a perspiring class of men.

◆

Send for our Cash to Canvassers Circulars **and make $25 before Christmas.**

SMALL COMPOUND ENGINES.

The design herewith shown is for a small compound engine for a 30 foot launch. The cylinders are 3″ and 6″ by 5″. There are no dimensions marked on it,as they can be easily supplied by anyone competent to build the engine. Piston valves are shown, but slide valves would be better, we think,for so small engines. There is no link motion, a radial gear being used instead. This simplifies the construction and lessens the cost very much.



The heighth of this engine should not exceed 24″ over all, and the weight—estimated —150 pounds. It can be run at 600 revs. per minute, if steam enough can be made for it. The designs are by the Bureau of Steam Engineering, U. S. N. The statements made for it are our own.

◆

YARROW'S WATER TUBE BOILER.

A **new** water tube boiler recently patented by A. F. Yarrow, of England, is shown herewith.

" According to this invention an upper cylindrical water and steam chamber A is formed in two halves secured together by flanges A^1, and connected to two bottom water chambers by water tubes C. The lower chambers are constructed of a semicylindrical part B^1 closed by an approximately flat cover B^2 bolted to flanges on B^1, and having holes into which are screwed or otherwise fixed the lower ends of the tube C, the upper ends of which are also fixed in holes formed in the chamber A. The furnace D is situated between the bottom chambers B, B, the flames being made to pass transversely between the water tubes on the way to the uptake E. Baffle-plates may be provided between the tubes C so as to cause the flames and the combustion gases to take a circuitous course."

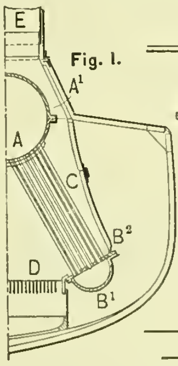


Fig. l.

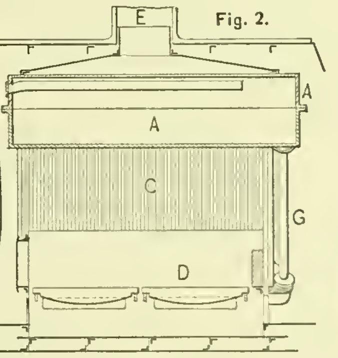


Fig. 2.

◆

Edward Marsland is now with the Guarantee and Accident Lloyds, 87 Wall Street, N. Y., as inspector of their risks.

We do not propose to enter at present into a discussion of the details of the methods of measuring the efficiency of steam engines, and the standard to be adopted, beyond protesting against results which have been obtained by supposing the work to be done under certain very definite conditions being applied to engines working under very different arrangements. What is known as Carnot's law has been sadly abused, and its mathematical expression has been applied to all sorts of conditions, from the raising of steam in a boiler to the working of a quadruple-expansion engine, and when absurd results were obtained the uselessness of theory was dwelt upon instead of the shallowness of the critic's knowledge. We must confess, as we have often pointed out, that writers on the theory of the steam engine, and especially on the applications of thermodynamics to it, have erred very much in their methods of presenting the subjects to their readers. Take such a simple thing, for instance, as the expansion of steam, and we are usually told that it does not affect its efficiency whether it is expanded in one or in a series of cylinders, a statement which, if it had been depended upon by practical engineers, would have prevented all the recent developments of the steam engine. Yet this statement is true, in a sense, and the same remark might be made about almost all the other expressions of the laws of thermodynamics. This is a large subject, and we cannot enter into it at present.—*Industries, England*.

◆

It seems some little progress is being made in "down draught," that is, in conducting the draught downward through the fuel instead of upward. The difference is, that when the draught is downward and fresh fuel fed on top, the smoke and cooler gases are consumed by the incandescent fuel beneath. In the other case, the unburned gases and smoke pass away from the fire and are apt to find their way to the chimney.—*Industries*.

We don't see the progress. One of the oldest base burning stoves that we can recollect was a down-draught stove, invented by Dr. Nott, of Union College, Schenectady, over fifty years ago. The principle or the idea of feeding coal on the bottom of the fire is very old. Now that we come to think of it, people used to growl at Dr. Nott's stove.

◆

A **Bridgeport**, Conn., mechanic is spending money for nothing on a scheme for increasing the speed of vessels, to wit:

"The inventor claims his system will give a more uniform motion, and with the same horse-power exerted by the engines,will give far greater results. In other words, if 10,000 h.p. exerted on two propellers gives a vessel a speed of 20 miles an hour, the same power exerted on three propellers will give 25 miles an hour."

Why? The propeller has no power in itself; it only transmits what it receives, so if there is to be more speed there must be more power from some source. No more efficiency can be got out of the 10,000 h.p. with three screws than with one.

◆

Another experiment has been made with Dr. Justin's dynamite cartridge, this being the third attempt. A twelve ton Blakely rifle was used. The shell weighed 275 lbs., containing sand instead of dynamite in the inner cartridge. The shell was fired into a sand bank, and was recovered in about the same condition as when fired.—*Press Dispatch*.

A *dynamite* cartridge made of sand won't explode; it is much the safest.

◆

It is said that an Australian photographer secures excellent pictures at a distance of sixteen miles.—*American Machinist*.

From where?

Letters to the Editor.

To avoid misconception we state that this department is open t all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

UNCLE SILAS SHORES US UP.

Editors ENGINEER:

I read your paper with great interest, each number, for although I am no longer in the trade, I have not forgotten when I was, and THE ENGINEER so faithfully depicts the life and trials of the trade that it is easy to see that the editor is "to the manor born," or rather that he has been a part of what he describes, or records so well. My compliments, and more power to him, whoever he may be.

But, Messrs. Publishers of THE ENGINEER, more than all else I prize your paper for its words of good cheer and hearty encouragement to the rising generation. We old fellows have had our day; let them have theirs, and let us do all that we can to make it a bright day for them. God knows that the lot of many is hard and bitter, and sometimes crushes the life out of many an aspiring young man. I suppose this is in accord with nature's law of the survival of the fittest, for none but the strong can live through what some have had to. My calling in life has brought me into intimate contact with many young men, and the trials some have been called upon to go through would have swept away any but the strongest. When you advise young men to "stick, never let go," you give them the very best counsel, for of all other things persistence is the most valuable quality. There are times when an opportunity is not at hand, or some one is in the way of preferment ahead of an ambitious man, and then it is that the sticking qualities are of great value. Young men want to achieve eminence and prosperity at a bound, they want to reap where they have not sowed, forgetting that there must be a crop put in before a crop can be taken out. I did not intend to write a sermon, so will stop before I put everyone to sleep.

Messrs. Editors and Publishers of THE ENGINEER, let me thank you for one thing particularly, and that is that in the five years in which I have read your paper I have never seen any irreverence, disrespect for or careless mention of sacred things. We do not all think alike in this world, yet there are but few right-minded persons who are not shocked at trifling with the Word of God or His teachings. Messrs. Editors, in common with others, I thank you for this, because it is not a little thing in the influence of a paper and its reputation among those whose good will is worth having.

Philadelphia, Pa. UNCLE SILAS.

["Uncle Silas" has our sincere thanks for his encouragement in all lines, and we need not say that his views are ours because he has already told us that our views are his. So we are in accord. We permit correspondents to "express their own views in their own way," and therefore do not excise the last paragraph of "Uncle Silas's" letter to us, for we are with him heartily in respect for sacred things. A man must be "off" somewhere who mocks at things he knows nothing about, or tries to compete with the Almighty in wisdom. We do not go further than this, because we consider that our journal is devoted to secular rather than sacred matters, "Uncle Silas's" words of cheer help all of us.]

◆

FLYING MACHINES.

Editors ENGINEER:

Seeing that you are devoting some space to flying machines, I write to say that it seems to me a favorable time to renew attempts in that direction. With the advent of aluminum, a metal is provided at a low cost which seems to be a distinct advantage to machinists, and since the steam engine has been greatly reduced in weight, power seems ready to hand. Although of a sanguine nature, I must say that it seems to me that it will be some time yet before men will rise above worldly things, for not all of the necessary conditions are known. Parrots are smart enough to repeat what some one has taught them, but if they were only able to teach others the secrets of flying they would benefit the human family amazingly. In all of the schemes so far put forth I see no mention of the great difficulty to be met in providing water for steam purposes. Even if the boiler and engine are reduced to very low weights per horse-power, and gas fuel is used, there still remains the water problem, and this there is no getting around. Water, weight for weight and pound for pound, must be carried, and high-speed engines (yes, and high speed boilers, too), will consume a lot of it. Two thousands pounds of water at 20 pounds per h.p. per hour will carry one hundred h.p. just one hour, when the air-ship of the future will have to descend within twenty feet of some sheet of water, and fill her tanks again. This is not an insuperable difficulty, but it is one that must be taken into consideration. I need not trouble yet awhile. I think, about details, but I am very sanguine that a machine can be made which will leave the earth and float in the air by means of mechanism. None of the plans which I have yet seen will answer.

New York. FLYER.

STEEL CASTINGS, ET AL.

Editors ENGINEER:

I see by your issue of the 8th that you retain a very vivid recollection of the difficulties encountered in the early days of McHaffie's steel (?) castings.

In reading your remarks, the whole affair came back to me, and I was glad that the troubles' were past, and not of the present. Then my mind ran back to the first steel tyre imported, when master mechanics of such roads as the Reading took them with considerable doubt and fear, and later on, when the first steel rails were imported for Pennsylvania R.R., (they all broke to pieces the first winter), and the Reading R.R. was asked to take 200 tons. The master mechanic said:

"Now see here! You have got us to use steel tyre on an iron rail and it works well, but now you want us to put down steel rails. How do you suppose our engines will get over the road if we do? Why sir, there would be little or no friction, and the wheels would just fly round."

Such theories look foolish now, but in their day they had weight and deterred people from giving orders. J. H. M.

Philadelphia, Pa.

◆

A BIG DIFFERENCE.

Editors ENGINEER:

What is the difference between twelve square inches and twelve inches square? You will settle a row around the shop stove, whatever way you answer, because we have agreed to abide by what you say.

Philadelphia, Pa. J. McS.

[Twelve inches square enclose a rectangle, which is 12″ long on each side; the superfices are 144 square inches, or one square foot.

Twelve square inches is a rectangle 3″ × 4″ on the sides, and the superfices are twelve square inches. The difference between the two, therefore, is 132 sq. inches.—EDS.]

◆

TOO LATE!

Editors ENGINEER:

I take pleasure in enclosing you ticket for our second annual Thanksgiving Ball, and hope you can be present, if only for a few minutes. We will present each ticket-holder with a souvenir worth more than the price of admission.

R. G. DAVIS.
New York. Chairman Committee.

[Thanks for the attention. We would not make a very good show at a ball nowadays. The bail is not at our feet any longer.]

◆

THE '*Concord*,' U. S. N., has just made her trial trip, but the details are not known as we go to press. Through negligence of someone, the steering gear was reported in order when it was not, and it was not found out until the ship got under way. Not a moment was to be lost, the stream at the time being full of vessels. Pilot Francis W. Bell brought the vessel under complete control, and to the wonderment of all on board, headed the '*Concord*' for Hell Gate. The engines had to be kept going. To have stopped them for an instant would have meant certain destruction, for the tide and current would have swept her on the rocks. Luckily the '*Concord*,' is a twin-screw. In a few minutes, which seemed ages, the '*Concord*' ran past the dangerous Gate. Pilot Bell turned to Commander Batchelor and nodded just as the latter exclaimed, "Well done, pilot! That is the first time a vessel was ever taken through Hell Gate without a rudder."

On reaching College Point the '*Concord*' was stopped, and in fifteen minutes her crew had the steering gear working perfectly. The trouble arose from the pins which keep the rudder amidships not having been withdrawn. The steam steering engines in consequence pulled the steering gear badly out of shape. Captain Woodhull declares that the steering gear was reported to be ail ready before he started the engines. The neglect, however, very nearly cost our navy the '*Concord*.'

◆

TWENTY-FIVE dollars is twenty five dollars, and you can make this amount by canvassing for THE ENGINEER: if not that sum, a lesser one for lesser service. Send for circular.

We give no chromos, buggies, houses and lots, or farms to suscribers, but we pay cash to canvassers who will scour their diocese for trade. Send for circular.

◆

THAT the coming armor-plate is to be of nickel alloy steel can hardly be asserted from the results of a single trial; that it will be thoroughly tested, the appropriation of a million dollars for the purchase of nickle ore and pig clearly testifies.

MARINE ENGINES.

WE seldom or never hear a complaint concerning marine engines. As a rule, they give no trouble, although they are kept running without stopping for an instant for astonishingly long periods. There is really no good reason why, if an engine can make a hundred revolutions, it should not go on to make one hundred thousand without stopping. We hold that the perfection of the modern marine engine is due in great measure to the guarantee system. A marine engine is guaranteed for a period of six or twelve months, according to arrangement, and a portion of its price is retained by the shipowner. The maker puts his own chief engineer in charge, and he naturally does all he can to make the engine perform satisfactorily for the guaranteed time. If there is a breakdown the engine builder must make it good at his own cost and charges. The result of all this is that the guarantee chief engineers report continuously to headquarters. They quickly find out the weak places, and they can see the drawings of other engines being built by their firm, and suggest improvement. In not a few cases the head draughtsmen of engine building firms make voyages on purpose to acquire practical experience in the working of the engines, and the advantage gained in this way is very great. Unfortunately there is little or nothing of this in land engine practice. Too much reliance is placed on text books, drawing office traditions, past reputations built up by men of great practical experience, and so on. The end will be disastrous, and the business will drift ultimately into the hands of those who do their work on a different system.—*London Engineer.*

◆

THE condensing apparatus of the '*Cushing*,' U. S. N., is peculiar. There is one surface condenser containing 1,052 sq. ft. of surface; it lies on the keel in the after end of the engine room, the tubes running fore and aft. The heads are conical and continue down through the bottom of the hull about 8 in., forming a scoop for the circulating water to enter and discharge when the vessel is under way, the cooling water passing through the tubes once. The forward scoop is provided with a strainer, the after one is without, the idea being that any foreign substance that may enter the after scoop when backing would be washed out when going ahead again. In the forward head are vanes $13\frac{3}{4}$ in. in diameter, forming a centrifugal pump and driven by a single vertical engine 4 in. diameter by 4 in. stroke. This engine and pump are used when the vessel has no motion through the water. When running at a speed of about 20 knots, the steam is shut off the circulating engine, the engine and pump make about 100 revolutions per minute, by the motion of the water passing through it.—*Jour. Soc. Nav. Engineers.*

◆

A MAN recently died in this city at an advanced age who was at the very top of his profession; his fame was world-wide, and the amount of work he did was enormous; his income was enormous too, but he was a spendthrift, a bad manager, and a deceiver ever. Some slight allusion was made to these little defects in the notices of his death, but his faults were scarcely mentioned. This may be charity to the dead, but is it just to the living? Is a bad, great man, of more value to his day and time than the average man who strives to lead a decent life, and leaves but little more than a clean record behind him? We say no. The wind that blows is not more transitory than the bubble called fame, but the quality in men that lives forever is sterling character in every relation of life. Let it be said of us when we have gone off watch: "He was a square man"—and all else can be omitted.

◆

STEAM is a willing servant, and will turn any crank and ask no questions; but it deends upon who made the crank how long it eeps turning

AN ECONOMICAL ENGINE.

The triple-expansion engine built by the E. P. Allis Company, Milwaukee, for the Narragansett Electric Lighting Company, has recently been tested by Messrs. Leavitt and J. T. Henthorn, engineers, and their report has been presented. The engine is a Reynolds-Corliss triple-expansion, with cylinders 14, 25, and 33 inches in diameter, and 48 inch stroke. The high-pressure and intermediate cylinders work tandem on one crank, and the low-pressure on another crank at right angles to the first. The high-pressure cyinder has one piston rod, and the intermediate pressure cylinder two piston rods and a tail rod connecting with the high-pressure cylinder, and the low-pressure cylinder two piston rods. The cylinders are steam-jacketed in the barrels only. The valve gear is the Corliss, and the valves are in the cylinder heads. The high-pressure cut-off is regulated by a centrifugal governor; the intermediate may be regulated by the same means or by hand; and the low pressure cut-off is regulated by hand. Low-pressure valve gear is worked by two eccentrics, one for steam and one for exhaust. The condensing apparatus is independent of the main engine, and consists of a surface condenser, a plunger circulating pump, a single-bucket lifting pump, and a Corliss type steam cylinder, 12 by 16 inches, working both pumps by crank connections. A contract condition was that the engine was guaranteed to develop an indicated horse-power with an expenditure of 126 pounds of feed water evaporated into dry steam per hour when running at 125 pounds of steam and at 100 revolutions per minute. The test was a night's run of ten hours, and the load was a trifle over 500 arc lights. Feed water was not measured on account of leakage from the boilers, but water discharged from the engine was weighed and afterward discharged through a meter as a check in the weighing. Indicators were put on all steam cylinders, one in each end of the cylinders, and the six indicators on the main engine were electrically connected, so that all cards of each set were taken simultaneously. The average indicated horse-power of the main engine was found to be 515.70; of condenser engine, 16.41; and the aggregate 532.11 horse-power. The net steam used by the engine was 68,840 pounds, giving 12.94 pounds of steam per indicated horse-power per hour. The engine was badly handicapped by moist steam, however, for the water entrained, as shown by calorimeter test, amounted to 6.39 per cent. The steam per horse-power per hour was 0.34 pound, or 2.7 per cent. in excess of the guarantee, but Mr. Leavitt states that the 7.39 per cent. of water in the steam would make a difference of at least 10 per cent. less duty than would be performed by dry steam, or not less than 2½ per cent. after extracting the weight of the water itself. He concludes that as the excess over the contract duty is so small, "I do not hesitate to express the opinion that the allowance for the small engine, plus the loss caused by wet steam, would bring the duty within 12.6 pounds." The purchasers have accepted the engine. It is understood that this is the first engine of this pattern which the Allis Works have built upon such a guarantee, and the price they receive will probably be of less importance than the achievement recorded.

[This, with the evaporation of tubular boilers under favorable circumstances—9 pounds of water per pound of coal—is equal to 1.33 pounds of coal per horse-power per hour, and is not an unprecedented performance. The stipulation for the engines of the '*Ohio*' Ss., running between Philadelphia and Liverpool, was that the engines should develop a horse-power for 1.25 pounds of coal per horse-power per hour, and they actually gave a horse-power for 1.20 pounds of coal per horse-power per hour.]

◆

Canvassers must adhere strictly to the terms of the circular.

ABOUT SAFETY VALVES.

So long as a safety-valve remains shut, the steam pressure acting on the underneath side of the valve is opposed by the weights of the load resting on the top, which may be either dead weight, a helical spring, or an arrangement of one of these acting through the agency of a lever.

Now, either by calculation or by trial, it is possible to proportion the load to the area of the valve so that the valve shall be lifted off its seat when the steam has reached any particular pressure fixed upon as the blowing-off pressure.

Thus, if the area of the under side of the valve exposed to steam is exactly 12 square inches, and the steam is required to blow off at 100 lbs. per square inch above the atmosphere, it will be necessary to provide a load $= 12 \times 100 = 1{,}200$ lbs., upon the valve, including the weight of the valve itself.

It is thus clear that the first condition, namely, that the valve shall open when the pressure reaches a certain determined amount, is not difficult to fulfill.

But now consider what happens when the valve opens.

The slightest amount of lift off the seat allows the steam to escape in all directions through the annular orifice between the edge of the valve and seat.

Its velocity is very great—probably 800 ft. per second.

The steam in the immediate neighborhood of the valve-seat escapes first, and its place is necessarily taken by other steam from the boiler, which also escapes.

A current is thus set up, not only through the orifice furnished by the valve, but also through the pipe leading to the same.

Now, a fluid will not commence to flow unless there is less pressure in front than behind.

When we find, therefore, that the steam is rushing up the pipe leading to the valve-seat with any considerable velocity, we may be certain that there is less pressure at the top of the pipe near the valve than at the bottom of the pipe next the boiler.

In the case of a dead-weighted valve, if it has to remain open and permit steam to escape, there must be as much pressure under the valve as balances the load on top.

And as we know that the pressure under the valve is less than the pressure in the boiler, the sole condition under which the valve can be kept open and allow steam to escape is that there must be some (however slight) *accumulation* of pressure in the boiler over and above the load on the valve.

For example, we may suppose the valve loaded to 100 lbs. per square inch, and the difference of pressure between the top and bottom of the pipe to be 4 lbs. when the steam is escaping.

Under these condititions the boiler pressure will become 104 lbs. when blowing off.

To trace the action of the valve more closely, we may say that when the steam first begins to blow off the valve will rise a very small distance off the face—so little indeed that the velocity of the steam up the pipe will be small, and the reduction of pressure at the under side of the valve inappreciable.

The small orifice thus opened being insufficient to relieve the boiler, an accumulation of pressure will result.

The extra pressure acting on the valve will increase the lift, until the reduction of pressure through the velocity of the steam in pipe is only just sufficient to balance the load on the valve as before.

If the boiler is still making steam faster than it is escaping a further accumulation will occur and a further adjustment take place.

But at any instant the pressure on the under side of the valve will always be 100 pounds above the atmosphere, even when the accumulation of pressure in the boiler is considerable.

Now, in order to prevent any considerable accumulation of pressure occurring when blowing off, it has always been the practice to make safety valves very much larger than the size of orifice actually required for the escape of all the steam which the boiler can make.

If an area of about 1-30 of a square inch is actually required for the steam to blow through, the Board of Trade require an area of half a square in the safety valve.

Such being the practice, it follows that safety valves only need to lift a small fraction of an inch off their seats when blowing off, thus avoiding much accumulation of pressure due to the cause we have been considering.—*A. N. Somerscales.*

◆

LAUNCH OF THE 'MAINE', U. S. N.

The first modern, high-powered, armored cruiser owned by Uncle Sam, was launched at the Brooklyn Navy Yard, Nov. 18, very successfully, and she now lies at her berth awaiting completion. She is known officially as cruiser No. 7, and to the public as the '*Maine*,' and is very similar in appearance to the '*Baltimore*,' shown on the first page of this issue. The construction of the '*Maine*' was authorized Aug. 3, 1888, at a cost not to exceed $2,500,000, and to be completed Oct. 3, 1892. Her keel was laid Oct. 10, 1888. It is probable that she will be completed by the specified time. When she is put in commission she will be a thoroughly American vessel.

Her hull was designed by the Bureau of Construction, U. S. N.; her engines and boilers are wholly the designs of the Bureau of Steam Engineering, U. S. N.; her guns and other armament are to be furnished from designs furnished by the Bureau of Ordnance, U. S. N.; her materials of construction are the products of American soil, American furnaces, and American rolling mills, and she was built in an American navy yard.

The contract for the machinery was awarded to the Quintard Iron Works, N. Y., at a cost not to exceed $735,000. According to contract her engines must develop 9,000 h. p., with premiums and penalties of $100 for each unit of horse-power above or below this amount. The '*Maine*' will have two vertical triple-expansion engines, separate water-tight compartments. The cylinders are to be 35½, 57 and 88 inches in diameter, with a stroke of 36 inches. There are eight cylindrical return tubular boilers, each 14 feet 8 inches in diameter and 10 feet long, with three furnaces in each. Forced draught is on the ash pit system.

The '*Maine*' has twin three-bladed screws 15 feet in diameter. The whole weight of the machinery will be 800 tons, and the total coal capacity 822 tons. It is expected that the '*Maine*' will be able to steam 960 knots at the rate of 17 knots an hour; 1,617 knots at rate of 16 knots; or 4,250 knots at the rate of 10 knots.

The '*Maine*' will be lighted with electicity, the plant for this purpose consisting of four dynamos and engines. Three powerful search lights for tracing torpedo vessels, rams, or other obstacles, will also be fitted. She will also be fitted with Lieutenant Bradley A. Fiske's range finder. In addition to the usual allowance of small boats, the '*Maine*' will have a steam launch and a steam cutter and two two large torpedo boats, each 60 feet long. These, with the armor belt, the machinery, and the other details, will all be fitted at the Brooklyn Navy Yard within the next two years.

The entire outfit of steam pumps are from the George F. Blake Manufacturing Co., including the hydraulic pressure duplex pumps for working the guns, etc., etc., and the independent air and circulating pumps for the main steam engines. The combined air and circulating pumps will be of the same type as those in the '*Chicago*' and '*Dolphin*,' which have been in successful operation for over six years.

◆

Steam is thick or thin according as it is hot or cold.

◆

Send for our Cash-to-Canvassers circular.

THE ENGINEER.

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VOL. XX. NEW YORK, NOV. 22, 1890. No. 11.

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PISTONS AND PACKING.

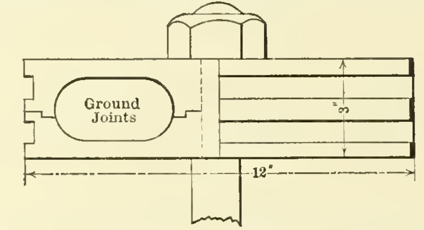
PISTONS and piston packing are vital points in the construction of steam engines, for, when improperly made, they not only cause a great deal of friction, but they also present an enormous mass of metal to be stopped and started on each stroke, and also reheated on each stroke.

We have never been able to see why a piston should be so much smaller than the cylinder it works in, as it is generally made There is certainly no practical reason in these days. Further, we have always objected to the very great weight entailed by very wide pistons. Concerning these views, we see in a late number of *Industries*, San Francisco, these remarks:

"Mr. Watson, of THE ENGINEER, who manages to publish a large amount of practical information on steam engineering matters, claims that a piston should fit in its cylinder, which is true, but in ordinary practice is hardly practicable, even if a cylinder is perfectly bored. The theoretical requirements are that a piston should "fit," and if there was some way to have it bear on the bottom half of its circumference and be "relieved" on top, that would be good practice for horizontal engines. A piston that does not fit, and but few of them do, bears only on a narrow line at the bottom. This, however, as Mr. Watson says, does not matter much "if the faces are wide enough." He "pulled us up," on this matter, some time ago, about piston faces, and as a warrant for the rule then given, we quote below dimensions employed at the Miners' Iron Works, in this city.

Dia. of cylinders, inches,	6	8	10	12	14	16	18	20
Length of piston, "	3	3½	4	4¾	5½	6¼	7¼	8

Mr. Richards, of *Industries*, has misapprehended our position, but the interpretation he puts upon our remarks is a natural one, from the way in which we expressed ourselves. "If the faces are wide enough" is ambiguous, and bears several constructions. By faces we mean the piston flanges themselves, not the extreme width of the piston.



It may be urged that one involves the other, but we think it does not. Example: A piston twelve inches diameter made by us would be 3″ wide on the face for a horizontal engine, and have two snap rings $\frac{1}{2}''$ wide on the face. This would leave 2″ for the flanges, which we affirm, with the piston made as in the sketch herewith, would be much more efficient than the conventional piston with immensely heavy "spider," followers, packing rings, follower bolts, *et al.* There is no reason why a piston should not be made to fit a cylinder closely, except that they never have been so made, and custom is a law unto itself. Cylinders can be bored nowadays so that they are absolutely true from end to end, and this being the case, the piston need only be the $\frac{1}{100}$th part of an inch smaller than the cylinders. This many good mechanics will say is absurd, but if they stop and think what a big dimension $\frac{1}{100}$th is when opposed to two diameters in the manner indicated, they will change their minds—possibly. One one-thousandth of an inch is a visible quantity when exhibited on a half-inch plug slipped within a hole one-thousandth of an inch larger than itself, and a good many will be surprised at trying such an experiment for themselves.

These are not our own views solely—as to pistons and piston packing—they are gathered and they are supported by current practice in all countries, and by engineers of all nations. The Ramsbottom locomotive piston is a simple wrought metal disk with a narrow flange. In this flange are two flat steel *wires*, possibly 3-16ths of an inch wide on the face. The locomotive is a high duty, high speed horizontal engine, and if a piston of the kind indicated will answer the rigid demands of its duty, certainly it should do the same work in an ordinary factory at ordinary piston speed.

OCEAN RACERS.

A RECENT issue, Nov. 9, of the New York *Sun*, says: "The commercial value of a steamship depends largely on the horsepower she develops and maintains steadily, and the quantity of coal she consumes. The '*City of New York*,' in a run of twenty-four hour, burns 335 tons of coal, which produces about 18,5000 h.p., with a boiler pressure of 150 pounds to the square inch. The '*Teutonic's* furnaces consume in a day about 300 tons of coal, creating about 17,500 h.p., (which she is credited with keeping up steadily throughout a voyage), with a boiler pressure of 160 pounds to the square inch. The pressure cylinders of the '*City of New York's* triple expansion engines are 45, 71, and 113 inches in diameter, respectively. The '*Teutonic's*' cylinders are 43, 68 and 110 inches in diameter. The piston rods of both boats have a stroke of 60 inches."

From these figures the reasons for the '*Teutonic's* superiority are obvious. The '*City of New York*' gets 3.11 h.p. less from a ton of coal. On a voyage of six days to Queenstown the '*Teutonic*' burns probably 210 tons of coal less than the Inman ship, thus saving about $750. It is said that the '*Teutonic*' can get more out of her coal because of a peculiar arrangement of her furnaces, by which a very large boiler surface is presented to the fires. The '*Teutonic*' has more than fulfilled the expectations of her owners. She has developed 17,500 h.p., and kept it up with little fluctuation for six days.

Until recently the '*City of New York*' has been unable to keep what Capt. Watkins calls an even pressure of steam. She has a nominal horse-power of 20,000, but her average indicated horse-power on a six days' voyage has never exceeded 18,500.

This is the kind of misinformation the daily press furnishes to the public upon technical matters, and the *Sun* is famous for its blunders in this direction. It never gets anything right. If the '*Teutonic*' develops 17,500 h.p., she must do it every minute, because that is the starting point in estimating horse-powers of engines. If she burns only two pounds of coal per h.p. per hour (a rate never yet reached for the entire steam plant in engines of her size), she burns 35,000 pounds of coal per hour. This amount is in tons of 2,000 pounds 17½ tons, and would be in 24 hours, a sea day, 384 tons. It is more probable that the '*Teutonic*' does not develop 17,500 h.p. than that she burns 384 tons per diem for the entire steam plant of electric light engines, winch engines, etc.

The queer figuring of the *Sun* upon the horse-power produced in the boilers by one ton of coal should be noted. This power, it says, amounts to 58⅓ h.p., and makes a horse-power come pretty high; $\frac{2\,000}{58.3}$ equals 37.5 pounds of coal per h.p., which is as one might say very dear, when it is produced every day for 3 pounds and less. The *Sun* has evidently guessed at 300 tons of coal per day and divided it by the gross horse-power per minute, a proceeding which gives the extraordinary result it obtained.

The facts given concerning the '*Teutonic*' are not facts. She does not keep her steam easily, and our authority for saying so is the statement of one of her engineers. She cannot keep 160 pounds, and does not average over 145 per trip. The actual horse-power developed by her engines has never been made public, but it would have been, had it been an achievement worthy of note, for such things have commercial value. It is evident that the person employed by the *Sun* has not the least knowledge of his subject—but he keeps writing on it just the same.

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THE elastic strength of one of the new ordnance rifles is about twenty-three tons. The pressure to which they are ordinarily subjected is about fifteen tons, so they have a margin of safety of over 50 per cent.

THE BATTLE WITH THE BOILER.

BETWEEN guns and armor a struggle has been going on ever since the '*Monitor*' and the '*Merrimac*' fought in Hampton Roads, and thus far the guns have the best of it, for no armor yet made has stopped comparatively small guns from penetrating it. A similar struggle, if we may so call it, has been waged between the marine boiler and the engine ever since the first steam vessel was built, and thus far the boiler is worsted, for it never comes up to the demands the engine makes upon it in high-powered ships. Cargo boats the boiler is master of, but fast ships defeat it always. The reasons are plain enough when we consider the demands made upon the boiler, the space it is possible to get for it, and the time it requires to manufacture steam from one minute to another. Considering this last feature of the case—the tons of water which have to be evaporated daily in high speed ships—it is wonderful that engineers are able to do as well as they do. In calculating boiler power for fast ships the designers get all they can in the space allotted, and are lucky if they are able to find room for the theoretical, or assumed requirements of the engines. Supposing that they do, there is still too little boiler, for these reasons: waste and leakage of steam are unknown quantities, and depreciation by use is another unknown quantity of very great importance. A new ship has a trial trip, we will say, and every thing is entirely satisfactory to the owners and contractors. There are no leaks, and the boilers are quite clean. They make all the steam required and more, and are cited, perhaps, as an instance of one ship, at least, which "has too much boiler." A year passes and the new boilers are scale-dirty inside, and fire-dirty outside. Strains have developed leaks; much more feed water is required than when the ship first came out, and the same old trouble is experienced again—there is not boiler enough.

It is safe to say that in one year the efficiency of a driven boiler will fall off, for the reasons given, ten per cent., and this estimate is a moderate one. It is a fact that some of the high-powered English ships cannot get over 150 lbs. of steam, average, where they kept 180 lbs. readily a year ago, a depreciation of 17 per cent. Leaks palpable and impalpable, seen and unseen, both in engines and boilers have done this with results which need no recapitulation.

NOTE ON BREECH PLUGS.

SINCE the office of the breech plug in modern rifled guns of large calibre is merely to fill up a hole and act on the gas check, one wonders why so much thread cutting is done on the breech of the gun and on the plug. The thread is never used as a thread; it is simply used as an inclined plane or cam to make the gun-breech gas-tight and resist the shot. The same end could be attained with much less expense of time and labor by a cam-groove milled in the breech and turned on the breech plug, making a stronger breech plug and cutting the breech less.

WE are no friends to paternal government of any kind, but think there should be some kind of restraint for the credulous, as there is for the idiotic and insane; some regulation for "commercial fools," who will pay money into endowment or other associations that promise returns in excess of the ruling rates of interest. If such a society should by some risky manœuvre use money to gain more than usual earnings, the profits would never be paid to subscribers, and we think the term "fool" is not any too strong for the dupes who ignore principles of commercial law, which are as fixed as those of mathematics. People see attempts to create values by legislation. combination, trusts, and other schemes, that make money by "manipulation," but such money is always lost by some one.—*Industries.*

NO MORE OCEAN RACING.

THE practice of racing steamships of rival lines across the Atlantic is to be discontinued, and we shall have no more falsehoods about vessels making 20 knots for impossible periods of time. Aided by wind and by sea, a high-powered ship may make 20 knots for 24 hours, but upon her own power and her own lines, there are but few vessels afloat which can make 20 knots for 24 hours At last the great companies have found out that it does not pay to attempt the impossible, and that no matter how many passengers are attracted by reports of high speed, the expense account is enormous. Engineers' crews will be glad to learn of this decision, for upon them came the brunt of the experiment.

"But the difficulties and troubles in the engine room of the racing craft are insignificant beside those in the fire room. 'When forced draught is used,' said one of the '*City of New York's*' firemen to a New York *Times* reporter, 'the heat in the firerooms in deep ships sometimes rises to as much as 150°. Everything is sacrificed to get air to the fires. The men must do without. To pass between the boilers means facing a temperature positively frightful. The engineers are often driven to their wits' ends to keep the men up to their work.' In the opinion of many transatlantic experts there never was a more unwise policy. Under these circumstances the steamship companies do well to abolish their races, for skillful firemen cannot longer be employed. It is the strongest men, the men who have the greatest physical powers of endurance, upon whom they must rely, and these do not contribute to the safety of the ship or its engines.

"By prolonging the duration of the trip across the Atlantic a few hours an enormous saving in coal is effected, but from a pecuniary point of view the saving of a few hundred tons counts for nothing, and probably was of no importance in the considerations that led to the suppression of the racing fever. The companies acted for the reasons already stated, namely, that the racers meant more costly ships with finer lines and less carrying capacity; great danger, especially from collision with bergs and ships, and extreme risk in the engine and fire-rooms. The question of vibration may also have been of importance. In one of the noted racers the vibration is so great that probably there are few passengers who would not beg the captain to take an extra day on the voyage in order that they might get a little relief from the constant jar of the machinery, and the bodily wear and tear from shaking and unrest. These are all excellent reasons, if any reasons are needed, why risks should be reduced to a minimum. The traveling public hereafter may not get to Europe at a five-day rate, but it will have a peace of mind and a sense of security that it never had before. In abolishing the frantic efforts of ocean steamships to break records, the companies, in the language of a New York agent, have taken a stitch in time, which, according to a time-honored maxim, saves nine."

Well, "to this complexion has it come at last." Readers of THE ENGINEER will bear us out in the statement that we have always protested against ocean racing upon the very grounds given above.

HERE is the latest "mechanical genius" discovered by the newspapers. Mechanical geniuses belong to the same family as the great society actresses who achieve greatness in a night. All fakes!

> "In 1889 I discovered the rotary engine. This engine differs from all others in these principles: It is simple, costs one-tenth less than other engines, and saves 20 per cent. of steam, and has no eccentric. There is no danger of explosion, and every ounce of steam is used from the boiler. This engine is made wholly under my supervision, and is now patented, and it is my intention to put it out in order to prove its merits, and will then sell it to any prominent manufacturer." (?)

Yes; and 50 years before this genius was born there were too many rotary engines.

"PRETTY GOOD WORK."

WE once stood by a bargain seeker in a market, who was chaffering over a lot of eggs. "Are they good eggs?" quoth he.

"Well," said the seller, "they are pretty good eggs."

What did he mean by that? Probably that they were not good at all; quite bad in fact, for there are no pretty good eggs in the world. They are either good, or they are bad. In precisely the same quandary was an inspector friend of ours who had to pass judgment on a lot of machine work which the most cursory examination showed to be bad. We cannot refit brasses that yawn at the flanges, and move sidewise where they are not intended to move. We cannot refit gibs and keys when we can stick cards in between them and the strap, and we cannot do a lot of other things over upon spoiled jobs which never should have been allowed to get past the scrap heap. Our inspector friend was in a quandary, because he was much too good-natured a man for his post, but his duty was so plain in the matter that he reluctantly notified the builders that if they would do this and do that (in reality do the job over again in its costliest details), he would let it go. "It is pretty good work," he said, amiably. "Pretty good work?" What is that? Is there any medium between a good job and a bad one? If there is, we have not found it. It makes no difference what the class of work is; it may shine with radiance like the fixed stars, or it may be rough and uncouth in its outlines; there is a standard of excellence for each. The hand and the eye of the mechanic shows in rough work as quickly as it does in smooth, and work is good or bad according to whether it is faithfully done with a view to endurance, or hastily done to get the buyer's money, and answer no letters of protest after it has been gotten. There can be no pretty good machine work; it admits of no qualification; it is either good or bad.

THE "Serve" boiler tube, so-called from its inventor, has ribs projecting internally for its entire length, and it is intended to increase the evaporating power of the boiler by augmenting the internal surface exposed, and its conductivity. This seems fallacious, for the capacity of the tube is bounded by its external surface and it can give no more than can be radiated by a given surface in a given time. Otherwise such tubes are objectionable, by reason of the impossibility of cleaning them, and by cinders or small coal getting between the ribs and choking the tubes.

Upon this device the *Boston Herald* says:

> It is claimed that by this change a saving is made of about 10 per cent. in the consumption of fuel—a claim which, if it can be maintained in general practice, *will tend to appreciably decrease the cost of those forms of transportation and production where steam power has to be employed.*

What this means we are unable to say.

THE opinion of all who have seen the '*Cushing*' has been in the highest degree favorable to her style of craft, and it is presumed that the general satisfaction which she has given has induced the Secretary of the Navy to send her abroad as a representative of one of the new and formidable types of the torpedo service of this country. That the '*Cushing*' would excite favorable comment in European naval circles there can be no doubt.—*N. Y. Times.*

We beg leave to differ. Germany and England have torpedo boats that far surpass the '*Cushing*' in speed. The spectacle of an American torpedo boat with a foreign boiler on board would not excite favorable comment we should say.

THE man who wants to rise in the world will try to learn from all sources, and will not be deterred because of ridicule. The jealous and envious, the ignorant, and lazy men, will try to pull him down, but no one can prevent a man who really wishes and means to get ahead, from achieving his ends.

Foreign and Domestic Trade Literature.

THE PROCESS OF STEAM IN ITS DEVELOPMENT OF POWER BY MEANS OF A STEAM ENGINE.*

By Chief Engineer Isherwood, U. S. N.

The steam jacket is a contrivance for maintaining the metal of the cylinder at the temperature of the entering steam, and thus preventing the liquefaction due to the heat interaction of the metal; the liquefactions due to the other specified causes are not, however, affected by the jacket; it does not touch them. As the result of the prevention of the liquefaction due to the heat interaction of the metal, there is no water of liquefaction to be revaporized during the expansion portion of the stroke of the piston, therefore the pressure shown on the indicator diagram by the expanding steam would be less than in the case of non-jacketed cylinders, were it not for the increase of pressure caused by the higher temperature of the jacket. As a practical fact, the pressure of the expanding steam in both jacketed and non-jacketed cylinders closely follows the Mariotte law, the increased pressure due to the jacket temperature when the jacket is used being about equaled by the increased pressure due to the vaporization of water of liquefaction when the jacket is not used. The heat imparted to the metal of the cylinder by the steam jacket is entirely utilized in the production of power by increasing the pressure of the expanding steam—superheating it—the temperature of that steam being maintained constant throughout its expansion and equal to that of the jacket steam, so that the pressures of the expanding steam are in exact accordance with the Mariotte law. The water of liquefaction drawn from the steam jacket represents the heat that has been imparted to the expanding steam and wholly used by the latter in the production of increased pressure upon the piston. The net result of employing the steam jacket is the prevention of all the liquefaction caused by the heat interaction of the metal and the expanding steam, without expenditure of heat therefor. The steam jacket places the cylinder in nearly the economic position it would have were it made of some adiabatic material, some material impervious to heat. If the cylinder metal were absolutely impervious to heat, the pressure of the expanding steam in a steam jacketed cylinder would be as much less than the pressure according to the Mariotte law, as was due to the loss of heat transmuted into the power developed by that steam James Watt considered the steam jacket to be his greatest invention, and there can be no doubt, from the point of view of intellectuality and complete originality, of the accuracy of that opinion, although he did not know either the rationale or the limits of its efficiency. It was a real inspiration of genius. The efficiency of the steam jacket is mainly connected with the expensive use of steam, and is in proportion to the measure of expansion with which the steam is used. When the steam is used without any, or with but little, expansion, the advantage of the jacket is nothing or next to nothing, and how Watt, whose practice was restricted to low-pressure steam, used with very little expansion, could have formed so high an opinion of its economic value under such limitations, is inconceivable. His estimate of its efficiency was strangely exaggerated, and the reasons he assigned for its beneficial action were both erroneous and inadequate. After Watt, low pressures and small expansions remaining still the rule, the steam jacket fell into disuse, as its economic results in such cases proved too small to justify the construction expense and supervision trouble connected with its employment. However, since high pressures and large expansions have become the general practice, the steam jacket has been reintroduced, and the economic gain obtained by it under these conditions fully sustains the exalted opinion which its inventor always had of it.

Beside the steam jacket as a furnisher of heat externally to the metal of the cylinder, there are three other sources, namely, the heat carried by conduction from the valve chest of the cylinder, the heat generated by the friction of the piston, piston rod, and slide valve, and the sensible heat produced by the cushioning of the steam in the cylinder. The first two of these sources of heat are obvious, the last requires explanation.

The cushioning of the back pressure steam is effected by the closing of the exhaust port of the cylinder before the piston reaches the end of its stroke, thus imprisoning whatever back-pressure steam then remains in the cylinder. The piston, continuing to advance, compresses or "cushions" this steam, increasing not only its pressure by the compression, but its sensible heat by the thermal equivalent of the work done by the compression. Now the back-pressure steam, thus heated by the work of compression, is in contact at the commencement of the compression with the metal of the cylinder at the temperature of the back pressure just previous to the commencement of the compression. From the moment, therefore, that the cushioning commences, the cooler metal takes up heat from the cushioned steam and liquefies an equivalent portion of it. This continuous compression, generation of sensible heat, and abstraction of the same by the metal, continues until the end of the stroke of the piston is reached. The metal thus abstracting a large portion of the heat of compression, has its own temperature correspondingly increased, with the economic result that less of the steam entering from the boiler on the opening of the steam port, is liquefied by that metal. The compressed back-pressure steam, having its temperature at the commencement of the compression the same as that of the metal with which it is in contact, increases very slowly in pressure owing to this abstraction of heat, and a great deal of compression is required to produce much of a "cushion" curve on the indicator diagram. The experimental curve varies enormously from the theoretical one. In fact, considerable reduction of space takes place before the curve sensibly commences, the liquefaction by the cool metal being equal to the compression. When the compression has reached a certain degree, and consequent high temperature, the liquefaction of the compressed steam has become so great that there is no further increase of pressure, and the curve rather abruptly changes to nearly a horizontal line, showing that the abstraction of heat from the steam by the metal has become equal to the heat put into the steam by the compression. This appearance can always be observed on the diagram if the steam eccentric be set "late," so as not to give "lead" to the entering steam, but, on the contrary, opening the steam port a little after the piston has commenced its return stroke. When there is steam "lead" this appearance is masked, but it is always there, and the cause of it renders any cushioning up to the pressure of the entering steam very difficult to obtain; hence, nothwithstanding the greatest practicable amount of cushioning, some steam lead is always found necessary to fill the waste spaces at the end of the cylinder with steam of boiler pressure at the commencement of the stroke of the piston. Were it not for the air mingled with the back-pressure stem, the "cushion" curve would be much less than it appears on the indicator diagram.

Evidently, all the heat of compression put into the back-pressure by the cushioning, that was abstracted by the cooler metal of the cylinder, upon which the cushioning was effected, went to increase the temperature of that metal, and to thereby reduce its liquefying power upon the steam entering from the boiler on the opening of the steam valve. The temperature thus imparted was a clear thermal gain; the bulk of pressure cushioned reproducing the power expended in the cushioning. The entire indicator diagram, measured down to the zero line of pressure, represents the entire dynamic effect of the steam per stroke of piston; the weight of steam expended to produce this diagram is also evidently the weight entering the cylinder per stroke of piston from the boiler, plus the weight of the cushioned steam; and, just as evidently, the weight of steam entering the cylinder from the boiler per stroke of piston, produces the whole of the diagram, excepting the cushioned portion, that is, the portion between the zero line and the back-pressure line during the cushioning portion of the stroke of the piston, so that, consequently, this portion must be produced by exactly the weight of steam cushioned. Hence, there is neither loss nor gain dynamically by cushioning; but there is in all cases the thermal gain described.

As an illustration of the effect exerted upon the cushioning by the temperature of the metal of the cylinder, may be stated that the cushion curves formed with the same mechanism, the same back-pressure, and the same point of closing the exhaust port, are very different, according as the steam entering the cylinder is of higher or lower pressure. As the pressure of the entering steam is lowered—its temperature lowering with its pressure—the temperature of the metal of the entire cylinder is lowered, the same measure of expansion being used, so that when the cushioning commences, the back-pressure steam is compressed upon metal of lower temperature than would have been the case had the entering steam been of higher pressure and temperature. The result appears on the indicator diagram in the smaller curves of the cushioning, these curves becoming less and less marked as the pressure of the entering steam is more and more lowered. The curves, as the entering steam is lowered in pressure, seem to commence later and later, and to rise to a less and less height, the liquefaction during the compression becoming greater and greater in proportion to the less and less temperature of the metal of the cylinder.

There is an absolute practical necessity in order to avoid shock from concussion, to bring the piston and its attached parts to rest slowly as the end of the stroke is approached, and to have the waste spaces at the end of the cylinder filled with steam of the boiler pressure ready for the return stroke, and to have such an opening of the steam port as will maintain this pressure with the moving piston up to the point of cutting off the steam. All this is accomplished by giving the steam valve "lead," but the method entails a serious economic loss. The steam admitted during the lead simply adds to the back pressure against the back pressure, and nothing is recovered from it; the additional back pressure is a total dynamical loss. Hence, these waste spaces should be filled as much as possible by cushioned back pressure, and the "lead" reduced to the minimum possible. In this way, if the setting of the valve has been judiciously done, a further gain can be indirectly made by cushioning.

There has been shown in the case of a non-steam-jacketed cylinder, that during the portion of the stroke of its piston between the commencement of the stroke and the point of cutting off the steam, the cylinder acts as a surface condenser, liquefying sufficient of the entering steam to furnish the heat needed to raise the temperature of the metal of the cylinder from the back pressure temperature to the temperature of the entering steam. But from the point of cutting off to the end of the stroke of the piston, and during the whole of the exhaust stroke, the cylinder acts as a boiler, boiling off and revaporizing the water of liquefaction deposited on the metallic surfaces during the portion of the stroke between its commencement and the closing of the cut-off valve. Now, there can be known by calculation whether all of this water of liquefaction is revaporized during the expansion portion of the stroke of the piston, or whether some of it is revaporized during the exhaust stroke while the exhaust port is open. If it is wholly vaporized during the expansion portion of the stroke, leaving nothing to be boiled off during the exhaust stroke, a very valuable and interesting result follows, namely, the determination experimentally by weight of nearly all the steam liquefied by molecular action as distinct from the weight of steam liquefied by metallic interaction, both being experimentally determinable.

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*A Lecture delivered before the Sibley College of the Cornell University, Ithaca, N. Y., December 13, 1889.

(To be continued.)

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LUBRICATING OILS.

Before dealing with the oils used for lubrication, it is necessary to consider what constitutes an efficient lubricator. A good lubricating oil must have sufficient body to keep the surfaces between which it flows from coming into contact, hence the reason why high gravity oils are now so much used on all classes of machinery; but at the same time everything depends on the class of work on which the oil is to be employed. If for light machinery, a very heavy oil would have a tendency to clog the bearings, thus impeding the speed; therefore for all ordinary machinery an oil ranging in gravity from .850 to .890 should be employed; whilst for heavy machinery, oils ranging from .900 to .980 should be chosen.

Another important feature is to obtain oils having the greatest amount of fluidity consistent with body. Many oils are selected because they are apparently of high gravity, but such is not always the case. The commonest kerosene burning oils can now be given an artificial gravity resembling castor oil, and yet immediately they become heated, even to a moderate temperature, they run off the bearings like water. Many of the Russian mineral oils now on the market have a gravity of about .920, are very highly refined, and of a splendid color, and yet when heat is applied they instantly lose their gravity, become limpid, and are quite useless for the purpose for which they are required. Russian oils are very useful in making up compounds with oils not affected by temperature, as they supply body to an oil which, although an excellent lubricant, could not be used for heavy machinery on account of its low gravity.

Another point to be considered is to find an oil with a maximum capacity for receiving and distributing heat, together with a freedom from tendency to gum or oxidize, hence none of the drying oils should be used for lubricating purposes, and under this head users of lubricants must be warned against a process which has lately been discovered of adulterating lubricating oils with soap, by which is produced a very fine sparkling oil of gravity higher than castor, but utterly useless for lubrication. Users of lubricating oils often lay far too much stress on the color of the oil, but with many methods now known of giving any oils, good or indifferent, any color, either ruby, golden or black, by the addition of the smallest percentage of the many aniline colors soluble in oils, the color should no longer be taken as a test of quality, all that is required being that the oil should be bright and free from insoluble matter. It is essential that a lubricating oil should be neutral—that is, it should neither be acid nor alkaline. In the refining of many kinds of oil, mineral acids and alkaline earths are used, and, especially in the cheaper oils, sufficient care is seldom exercised in washing them free from all traces of acid; it is well-known that some manufacturers often leave a large portion of alkali in the oils, as this greatly helps to make up their gravity.

Having now dwelt on what are the requirements of a good lubricant, the next step will be to describe several ready tests by which the utility of the oils can be quickly determined; not tests and analyses which can only be worked by competent chemists, but ready methods which can be employed by any ordinary user of machinery. With regard to the gravity, this is an essential step, and in order to find this we have gravity bottles, Sprengel's tubes, etc., all of which necessitate the use of a balance. The simplest method is therefore to use an ordinary hydrometer. The oil is placed in a cylindrical glass vessel, and the hydrometer floating in the oil marks the gravity immediately, taking water as 1000. This method is very useful, because the gravity of the oil can be determined at any temperature; while by the more complicated methods it is very difficult to determine the gravity at any other temperature than that of the ordinary atmosphere; but with the hydrometer the glass vessel can be heated in a water bath, and the gravity taken by placing the hydrometer in the oil at any moment. By this means it can be seen if the sample retains its original gravity when heated.

The "flashing point" of an oil is understood to mean the temperature at which the escaping vapor will momentarily ignite. The standard animal and vegetable lubricating oils, and all mineral oils of good body and high gravity, decompose or vaporize only at temperatures exceeding that of steam in ordinary engines, but nevertheless many of the lubricating oils now in the market are so worthless that it is very essential to know a ready means of ascertaining their flashing point. Many very good forms of testers, such as Abel's, Bernstein's, or Bailey's, are used, and they are all more or less on the same plan, namely, consisting of a metal receptacle for containing the oil surrounded by a water-bath with a lamp for heating the bath. The vessel containing the oil is closed, with the exception of a small aperture through which the vapor ascends; a small gas jet is continually played over this aperture, and instantly the vapor flames the temperature is noted, this constituting the flashing point of the oil. But all these testers require very careful manipulation, and the writer suggests a simple apparatus, which can be worked very easily, and at the same time gives very accurate results. A small glass beaker is fitted into a larger one by means of a cork or india-rubber band; the former is to contain the oil, the latter serves as a water bath. The smaller beaker is closed at the top by means of a cork, through which is inserted a thermometer dipping well into the oil, and a small piece of glass tubing tapering to a point, through which the vapor ascends. The oil should be on an exact level with the water in the outer vessel, so that the same pressure exists in both vessels; and when an oil to be tested is supposed to have a flashing point above that of boiling water, an oil bath should be used in place of water. Everything being ready, the apparatus is stood on a sand bath, under which is placed a spirit lamp, and gradually heated. A light is applied continually to the aperture through which the vapor from the oil is ascending, and immediately a small blue flame appears the temperatute is noted, and the flashing point of the oil under examination thus determined. Any oil having a flashing point below 300 deg. Fah. should be at once discarded as useless.

Another very important test is the viscosity or fluidity of an oil. A very simple and general test of fluidity is to dip blotting paper in the oil and hold it up to drain; symmetrical drops indicate good fluidity; a spreading tendency, viscosity. Again, an ordinary glass tube having a diameter of half an inch, tapering to a point at one end, and marked into divisions of 1 in., will answer all ordinary purposes for testing the viscosity of an oil. The oil to be tested is placed in this tube up to a given mark, and is then allowed to run out at the tapered end of the tube, and the time taken is noted. This is compared with the time taken by standard oils previously ascertained in the same tube, and thus the viscosity of the oil can be determined. Sometimes it is necessary to take the viscosity at different temperatures, and in this case the glass tube can be fitted into an outer jacket containing water heated up to the required temperature. For all light machinery running at high speed, low gravity oils having a low fluidity should be looked for, whilst for heavy machinery of all kinds high gravity oils, with a moderate fluidity, should be employed.

An oil evaporating more than 5 per cent. in twelve hours, at a temperature of 140 deg. Fah., is useless, as the evaporation creates a viscous residue, or leaves the bearings dry. To test for this, a weighed quantity of the oil should be placed in a porcelain dish and heated for the requisite time, then cooled and weighed and subtracted from the original quantity; the difference in weights constitutes the loss by evaporation.

(To be continued.)

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ALUMINIUM AND HOW IT IS MADE.

The works of the Pittsburg Reduction Company were organized in 1888: the process is that of Mr. M. Hall, and deals with the electrolytic reduction of an oxide of aluminium by direct and continuous method. Less than a year ago the results obtained by the experimental plant, consisting of a 125 h.p. high-pressure compound engine, and two dynamos giving a current of 25 volts and 1000 ampères, were so successful that the installation was increased to its present size, and is capable of producing 375 lbs. of aluminium per day. The material used is an oxide of aluminium, which is manufactured at Goldschmeidn, near Breslau; it is manufactured from bauxite, which is fused with carbonate of soda and forms an aluminate of soda, which being lixiviated in water is thown down as a white precipitate, and is exported to Pittsburg in that form; abundance of bauxite is met with in North Carolina, but it cannot be reduced so successfully nor at so moderate a price in America as it is in Germany. It is delivered in Pittsburg for about 5 cents a pound, including an import duty of 60 cents per 100 lbs.; it is probable, therefore, that it could be manufactured profitably in Europe for about 3 cents a pound.

The principle on which the process is based consists in the use of a molten bath of various fluoride salts, which are not decomposed by the electric current passed through them, but which when in a molten state decompose the alumina (AL^2O^3), separating the oxygen and gradually reducing the alumina to a metalic mass of practically pure aluminium. Prior to being treated, the powdered alumina is placed in a drying furnace, and moisture to the extent of about 33 per cent. of the whole weight is driven off; the white precipitate is then ready for further treatment. As carried out at the Pittsburg works, a series of open iron vessels or pots are placed on the floor of the melting-house near the wall that separates this portion of the works from the electric plant. The pots are of wrought-iron, and are lined with carbon, a depression or well being left at the bottom of each; a framework rising above each pot serves to support a series of iron rods, to the lower end of which are attached carbon electrodes; these bars are held in position by binding screws and are connected to the positive poles of the dynamos; the circuit is completed by conductors from the negative poles to the iron pots. Into these carbon-lined receptacles a quantity of the fluoride salts is thrown. When the current is passed through this mixture it rapidly fuses, but does not, it is stated, undergo any further change, nor any waste, except that due to accidental spilling, no matter how long it may be kept in a state of fusion. In this bath is charged a quantity of the alumina, the proportions being determined by experience; the process of reduction then commences, every particle of the powder being subjected to the action of the electric current by the action of the bath. The oxygen is absorbed by the carbon electrodes, and the contents of the pots are soon reduced to a metalic mass, which does not mingle with the electrolytic bath, the respective specific gravities being sufficiently different to prevent any mechanical mixture. As the contents of each pot are run down, small quantities of alumina are added, and from time to time, as the reduction has become complete, the metal is ladled from the well in each pot—the fluoride bath being easily separated—and is poured into moulds for subsequent re-casting. The process is thus a direct and continuous one, involving the expenditure of a large amount of electrical energy, but one into which the action of heat, beyond that necessary to fuse the electrolyte bath, and the alumina, does not enter. The re melting furnaces, of which there is a series sunk in the floor of the reduction house, are each only large enough to receive one crucible. In these the metal is re-melted and cast into small ingots, which are, it is claimed, of an average purity of 98.5.—*Engineering.*

FLYING MACHINES.

Hiram Maxim says in the New York *Times:*

"I have been studying this question about eighteen years, principally in the direction of finding some powerful and light motor, but during the last two years I have employed myself in working out the mathematical part of the problem. I have obtained all the data in German, French, and English. I have also examined the experimental apparatus in France, but am sorry to say that all the data and information so far obtained are of very little value. Some twenty five years ago a society was formed in England styled the Aeronautical Society of Great Britain, and the society numbers among its members noblemen and engineers of high repute. I believe there are nineteen different volumes in existence which give an account of all their procedures and experiments, but during all these years very little practical work has been done.

Experiments are being conducted by me with a view of finding out what the supporting power of a plane is when driven through the air at a slight angle from the horizontal. For this purpose I constructed a very elaborate apparatus, provided with a great number of instruments, and arranged in such a manner that I can ascertain accurately the efficiency of a screw working in air, the amount of power required to drive a screw, the amount of push developed by a screw, the amount of slip, and also the power required for propelling planes through the air placed at different angles, as well as to ascertain the friction and all other phenomena connected with the subject. I have been experimenting with motors, and have succeeded in making them so that they will develop one horse-power for every six pounds. My experiments show that as much as 133 pounds may be sustained in the air by the expenditure of one horse-power. It is premature to express any opinion; still, if I am not very much mistaken, I think I can assert that within a few years some one—if not myself—will have made a machine which can be guided through the air, will travel with considerable velocity, and will be sufficiently under control to be used for military purposes. I have found in my experiments that it is necessary to have a speed of at least 30 miles per hour—that 50 miles is still more favorable, and that 100 miles would seem to be attainable. Everything seems to be in favor of high speed.

In order to conduct these experiments I rented a large park—and erected a wooden shed of large dimensions. I provided myself with every requisite, and employed two eminent American mechanics to assist me—Mr. Henry A. House and Mr. Henry A. House, Jr., both of Bridgeport, Conn. These gentlemen have already been working with me more than a year, and both seem very confident of our ultimate success.

It is a fact that we see in nature machines which fly, some birds weighing nearly fifty pounds each; even a common goose can fly without any considerable effort. It is true that no one has ever taken hold of the question in the same way, and with the same appliances that I have. Most of the experiments have been confined to small machines, weighing only a few ounces, and having for a motor a twisted rubber string or spiral spring. If an experimenter has had the necessary intelligence and mathematical knowledge, he has not had the necessary room or money to conduct his experiments, and the results so far have been *nil*, but I feel satisfied that if such men as Westinghouse, Brush, and Edison should seriously attempt to solve the question, they would succeed in making some sort of machine that would fly. I would say that the two motors which I have made, and which weigh 600 pounds, cost their weight in silver, while an engine of very much less power, made by a French experimenter, cost more than three times its weight in silver.

STEAM ECONOMY.

The object of this paper is to consider as briefly as possible the uses of indicator diagrams as a means of ascertaining the deficiencies of marine engines, due to a wrong distribution of steam through its cylinders and steam chests, and how to use it (the steam) to the best advantage and effect a saving in the consumption of fuel.

We will look into the triple compound engine, as being the one most generally in use now, but the explanations given will generally, with equal force, apply to either the two, three, or four cylindered compound engine. It will simplify our consideration of the subject to suppose that we have joined a vessel fitted with a set of modern triple expansions, and have received instructions from our superintendent engineer to take off some cards, and also to make any alterations to the valves that we may think will be of advantage to the job.

After being two or three days out, and seeing that everything is apparently going smoothly, our indicator pipes quite clear, and indicator itself in good condition, we proceed to take three or four cards from each cylinder, taking particular notice to have exactly the same steam on the boiler gauge all the time, and not to alter the injection, link gear, or throttle valve in any way, while we are busy, so as to have the conditions exactly the same for each cylinder.

Having obtained the cards to our satisfaction, the next operation is to work out the horse-power shown by all the cards, and take the mean of the three or four cards for each cylinder, so as to be as accurate in the result as possible. A very important thing to aim at is to have the three cylinders developing the same horse power, or as near as we can get them. By so doing, the engines will run more evenly, there will be a better twisting moment upon the shaft, and we will have an equal amount of wear on all the top and bottom ends and main bearings, and considerably lessen the amount of overhauling required in the course of a voyage; as it is very often found to be the case, when a particular top or bottom end is running badly, and requiring a deal of attention, that that engine is exerting more power than it was designed for; so that the cause of the trouble is to be found inside the cylinder, and not at the bearing, and no amount of overhauling at the bottom end will put it right.

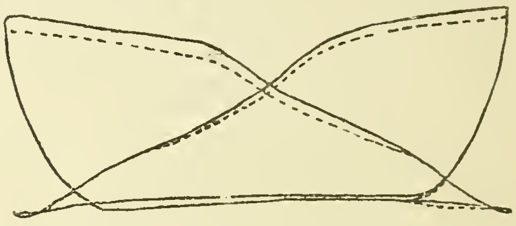
Most engines now are fitted with separate expansion levers, and it is astonishing what a variety of alterations can be made by an intelligent use of this means of linking up. We will consider a few cases that often occur, and can be altered without moving the sheaves.

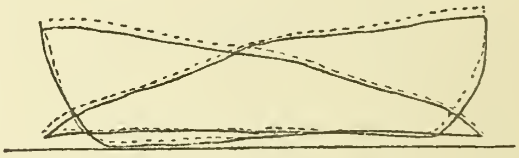
If the h.p. is linked up by itself, the effect will be to decrease the total horse-power of the engines, but the same ratios (or very nearly so) will exist between the relative powers, because if we decrease the supply of steam to the h.p. cylinder, it will also be decreased to the other two cylinders.

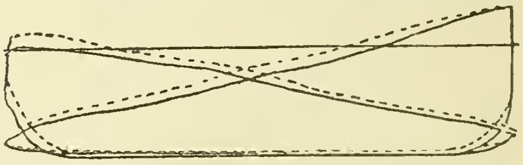
If we were to link up the intermediate gear, the result would be to decrease the power of the h.p. cylinder, and to increase that of the i.m.p cylinder; the l.p. will remain the same. This will, therefore, be found a remedy, when the h.p. is highest in power, the l.p. next, and the i.m.p. the lowest.

Linking up the l.p. will increase the power of that engine, and decrease the power of the i.m.p. by throwing upon it a greater back pressure, and the h.p. remains the same. This will, therefore, be our plan, when the i m.p. is highest in power, the h.p. next, and the l.p. lowest. Another case is to link up both the i.m.p. and l.p. and keep the h.p. the same. This will increase the l.p. and decrease the h.p., but the i.m.p. will remain as before, and this must be our alteration when the h.p. indicates the most power, with the i m.p. next, and the l.p. lowest.

Linking up all three engines by means of the reversing gear will make the same result on the ratios as the last example, but of course the total horse-power will be less. Should there be no expansion levers, a small amount of linking up can generally be effected by placing liners between the feet of the drag links and the adjustable brasses. Linking up is, of course, an acknowledged bad practice, if carried too far, because by so doing we shorten the travel of valve and obtain a slow opening and cut-off, thereby throttling the steam in its passage to and from the cylinder. But it may be used to advantage to a small extent, and is a very convenient way of altering the cut off, if better means are not provided—such as a separate expansion valve, or a different form of gear with means for varying the cut-off.







If a big alteration of power is required, it will be necessary to alter the sheaves; putting the sheave forward and piecing the steam edge of valve will have the same effect as linking up. I heard of one old compound job where the h p. engine was indicating 200 h.p. *more* than the l.p., and tearing all the brasses to pieces, but they were brought to within a few horse-power of each other by simply placing strips upon the steam edges of the l.p. valve and putting the sheave forward, thus making a better running engine and reducing the consumption as well. In a triple, if the l.p. is highest in power, the i.m.p. next, and the h.p. lowest, we must do the reverse of linking up, and that is to carry the steam further on the stroke. This will be effected by putting back the l.p. and i.m.p. sheaves and chipping the steam edge of valve.

Another undoubted source of economy is to compress the exhaust steam cushioning, as it is often called, and this is effected or increased by the amount of steam lap which is given to the valve, also by putting on exhaust lap. If we have a quick moving valve, it will be easily seen how the advantage of compressing the exhaust steam comes in, as it not only acts as a cushion to overcome the inertia of the moving parts preparatory to another stroke, but also raises the pressure, and consequently the temperature of the steam and cylinder sides and ends, ready for the incoming hot steam of the next stroke, thus checking the tendency to inital condensation and the necessity for heavy lead. Although compression diminishes the effective mean pressure, it has been found to increase the efficiency of the engine or the ratio of work done to steam expended.

Perhaps a great deal of this information may be old news to some readers, but as it is the result of practical experience, it will doubtless be of value to others.

An important point to study in the economy of the steam engine is the use of the steam jacket, but about the real value of which, as a means of effecting a saving in the consumption of fuel grave doubts have existed.

The diagrams may all speak for themselves, and are the result of a consideration of some experiments recently made on a triple-expansion fitted with steam jackets round the h.p. and i.m.p. cylinders, and the drains from which were led into the hot-well. In the case of the h.p. the pipe supplying the steam was rather small, being scarcely big enough to keep up a pressure in the jacket, as high as that of the incoming steam, and it is partly owing to this fault that the h.p. card shows a less mean pressure with the jacket than without. The other reason is that there was 4 lbs. less boiler pressure when the cards were taken with the jackets on, than when they were taken with them shut off. In all other respects the conditions under which both sets of cards were taken were identically the same, and it will be noticed that in both cases the total horse-power is the same. The full lines show the cards taken when the jackets were "off," and the dotted lines when they were "on."

	Steam by gauge.	H P.Cyl. Mean pressure.	H P.Cyl. Horse power.	I.M.P.Cyl. Mean pressure.	I.M.P.Cyl. Horse power.	L.P.Cyl. Mean pressure.	L.P.Cyl. Horse power.	Total Horse power.	Revs. per minute.	Vac.	Temp. of feed.
With jackets....	150	51.9	260	20.2	256	8.2	284	800	62	25½	156
Without jackets.	154	55 6	277	19.7	249	7.9	275	801	62	25½	139

LBS. WEIGHT OF STEAM USED PER MINUTE AS SHOWN BY DIAGRAMS.

	H.P. Cyl.			I.M.P. Cyl.			L.P. Cyl.			Lbs. of steam per I H P per hour	
	23".1	27" 3	31".5	27".3	31".5	35".7	27".3	31".5	35".7	Before expansion.	After expansion.
With jackets.....	139.2	145 2	142.2	164	167	170	143 5	150.5	162.5	10.44	12.2
Without jackets..	147	149.7	146 7	154	157	159	132.5	134	135 5	11.025	10.16

The tables are a collection of particulars obtained from the diagrams, and a careful study of them will reveal many facts of interest. The second part of the tables are the result of a calculation of the lbs. weight of steam used per minute, as found from the diagrams and taken at various parts of the stroke during the expansion of the steam, *i.e.*, between the closing of the steam port and the opening of the exhaust port. Of course, the diagrams do not take account of the quantity of water that may be in the cylinders by condensation or priming, but the gradual increase in the weight of steam in cylinders from the cutting off steam in the h.p. cylinder to just before the opening of exhaust in the l.p cylinder, show how enormous must be the re-evaporation when the jackets are on, while without them a big condensation is shown. It will be noticed that at the commencement of expansion in the h.p. cylinder with jackets, there are 139.2 lbs. of steam used per minute, but at the end of expansion in l.p. cylinder the diagrams account for 162.5 lbs., thus showing that there must have been 23.3 lbs. of water passing into the h.p. cylinders per minute, but which has been re-evaporated before the steam has reached the condenser; while without jackets, the card shows 147 lbs. of steam per minute at the h.p. cut off, but after expansion there is only 135.5 lbs. accounted for, and this points to the fact that 11.5 lbs. has been condensed during expansion. These two facts must be carefully noted, viz., that with jackets, there is a re-evaporation during expansion of 23.3 lbs. of water per minute, and without jackets, there is a condensation of 11.5 lbs. of steam in the same time, and this indicates a saving in favor of the jacket system of 34.8 lbs. of steam per minute. To set against this is the condensation going on in the jackets, which was found to be at the rate of 5.33 lbs. per minute, and 34.8—5.33=29.47 lbs. of steam saved per minute. This, however, is not an entire gain, as part of the steam did work in the h.p. cylinder, almost the whole of the condensation having occurred in the other two cylinders; but if we calculate the saving between the i.m.p. cut off and the condenser, it equals 20 lbs. per minute Now, working this up for twenty-four hours, and taking the evaporative power of the fuel at 8 lbs. of water per lb. of coal, there is a saving in the consumption of one and a half tons of coal per day. Had there been a jacket round the l.p. cylinder as well still better results would have been found.

To be successful in steam jacketing, it is necessary to have each jacket fitted with both steam and water gauges, the first to let us know when the pressure (and consequently, temperature) is as high as that of the incoming steam; and the second to give warning of any water that is accumulating —as if either of these points is neglected the jacket will be found to be a positive loss, instead of a gain.—*Engineers' Gazette.*

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THE British Admiralty, it is stated, has given orders for two of the new gunboats now building to be fitted with captive balloons. This is in accordance with the present practice in the French Navy. The practical advantages of the balloon were demonstrated during the recent manœuvres of the French fleet in the Mediterranean. The '*Formidable*,' one of the most powerful of French battle ships, is furnished with one of these balloons. When the vessel is steaming, it is towed behind, being attached with block and tackle to the deck. It can, therefore, be drawn down and manned, and, on the connection with the deck being severed, it ascends, but is still held captive by a rope made of silk for lightness, fixed on one of the military tops. This connection with the military top is always maintained. The balloon on the '*Formidable*' has 11,000 cubic feet of hydrogen gas, and ascends 150 feet or so. The French officers report that objects twenty-five miles distant can be seen from the balloon, whereas from the deck the horizon line is not more than eight miles distant. One other feature brought out by the trials was that an observer in the balloon was able to follow the movements of the submarine boat '*Gymnote*' without losing sight of it for a single instant, although it was a very considerable distance below the water level It must be remembered, though, that the waters of the Mediterranean are very clear, but the French assume that inasmuch as eighty feet could be penetrated there, ordinary sea-water objects could be seen at a good depth.

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THE Society of German Engineers, Europe, has arranged to offer two prizes of $720 each for the best papers on smoke prevention, one for steam boilers, and one also for domestic furnaces, with additional prizes of $240 for drawings.

◆

THE "Squadron of *Revolution*," as stated in our last issue in referring to the '*Chicago*,' U. S. N., is one of those charming inaccuracies which make life pleasant to an editor. We wrote *evolution*, but the compositor knew better.

THE allowance for shrinkage varies considerably in different shops, and ranges from $\frac{1}{300}$ to $\frac{1}{800}$ of the diameter. As the amount of gas used and the time occupied in heating is dependent on the allowance for shrinking, motives of economy should lead to the reduction of this to the smallest amount compatible with sound workmanship. The writer does not think it advisable to allow less than $\frac{1}{600}$, the diameter for wrought-iron, which he has found makes a good job. On the other hand, he thinks that $\frac{1}{400}$, which is the standard in at least one well-known engine works for both iron and steel shafts, is somewhat excessive, especially when the latter material is distributed in the most economical manner. Theoretically, the allowance should depend upon the modulus of elasticity of the material, but in practice this may be taken at 28,000,000 for the steel and iron used in marine shafts. The tension on the metal round the shaft or pin is calculated by multiplying the modulus of elasticity by the extension of the material. For an allowance of $\frac{1}{600}$ the extension will be $\frac{1}{600 \times 3.1416} = \frac{1}{1885}$ of the circumference, and the stress on the inside layer of metal round the hole will therefore be $M \frac{1}{1885}$, or 28,000,000 × .00053 = 14,840 lbs. per square inch, which is well within the elastic limit of wrought-iron. With an allowance of $\frac{1}{500}$, the stress would be 17,640 lbs., while for $\frac{1}{400}$ it would be raised to 22.120 lbs. per square inch.—*Mechanical World.*

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IT has been suggested repeatedly that a suitable motor for aerial navigation may be found by the invention of some kind of explosive engine, utilizing the force of gunpowder, nitro-glycerine or some other substance which can be flashed from the solid or liquid form to the gaseous condition; but such a motor is yet to be invented, and, what is more difficult, regulated and perfected. Attempts in this direction, notably with gunpowder, actually antedate the steam engine, but the difficulties of controling power so intense and so rapidly generated have hitherto been found too great to be overcome. It would be rash to say that they cannot be, although true explosive engines have thus far exhibited an unpleasant irregularity of working, frequently giving deficient strokes, but at times coming out with powerful explosions which may kill the inventor.—*Unknown.*

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WHAT we require is a plain economical traction engine embodying the best features of modern steam practice; plain gangs of common plows, pulled behind by the most simple mechanism possible. The fuel and its resultant, the kind of boiler, are principal points, so also are movable joints exposed to irregular strains and speeds while rocking and twisting; exposure to grit, making curves, climbing grades, adaptation to several purposes, also to hard and soft surfaces. These afford a wide field for designing and constructive skill, and at the same time point to an avoidance of detail as far as possible. The first and main point, one tolerably well settled now, is that for use in California a traction engine can draw a profitable number of plows continuously.—*Industries.*

◆

AN old subscriber says: "Would as soon think of going without my breakfast as to be without THE ENGINEER. I have eight years' numbers, all nicely bound, and points in engineering not touched upon in some of them are rather hard to find."

Thanks! "A word in season, how good it is."

◆

ORRIS root, from which all violet perfumes are derived, is devoid of odor when dug, and has to be dried in order to develop its qualities.

TRADE NOTES.

THE Navy Department has advertised for proposals for putting in a complete electric light plant in the New York Navy Yard. Bids will be opened at the department December 16.

* * *

THE steam yacht '*Stranger*,' well known in Eastern waters, has been sold to Joseph C. Hoagland, of New York, for $75,000. She will be enrolled in the Atlantic, American, and Shelter Island Yacht Clubs.

* * *

A CURIOUS cause for closing shops is found in this item. The glassware factory of Dalzell Bros., and Gilmore & Leighton, of Ripley, O., employing 350 hands, will shut down, owing to the strict enforcement of the anti-lottery law against baking powder companies, all of whom they have heretofore supplied with glassware, which was given away as prizes with baking powder.

* * *

THE Joseph Dixon Crucible Co., of Jersey City, who are the manufacturers of graphite paint, claim that it will successfully resist all chemical and atmospheric changes and outlast any other paint several times over. It is not a new article, but has been on the market for twenty years, and there are tin roofs in Trenton, N. J., that have been coated with this paint for fifteen years without repainting. The Pennsylvania Railroad are using it on their new line in Jersey City.

* * *

THE Supreme Court of the State has decided that the Grant Locomotive Works is secured in the possession of a large tract of land, which was purchased by the company December 21st last, at master's sale, for $602,000. Mrs. Hetty Green, who had been largely interested in the ownership of the land, considering the purchase price too low, averred error in the sale, and started extensive litigation, which has terminated as shown by the decision. This clears the title of the Grant Locomotive Works, and work will commence immediately.

* * *

THE fouling of iron and steel ships of war is a formidable problem at this time, and unless some better means can be invented of keeping the hulls clean, a navy will not be of much use. The '*Charleston*' is an example. She was in a few months rendered harmless or powerless for her intended purposes by fouling, so her speed was reduced one-half. There is at this office, at the time of writing, a "sample of barnacles" that stands four inches high. The heads of some of the "animals" are ¾ in. diameter, and the shells are strong enough to bear one's weight. A ship coated with a growth of these is as useless as though her engines were broken down.—*Industries.*

* * *

THE bids of the Risdon Iron Works of San Francisco, and the Fulton Iron Works, for finishing and assembling thirty-five twelve-inch rifled mortars, to be used as part of the defensive armament of San Francisco Harbor, have been rejected by the War Department, as being too high in proportion to Eastern bids for similar work. The lowest bid, that of the Risdon Works, was $2,445 each, against $1,850 each, bid by the South Boston Iron Works. This delays, for a time at least, the beginning of ordinance work on the Pacific coast, and it is doubtful whether a substantial beginning can be made unless Congress makes provision for contracts of considerable magnitude, at a sufficient advance over Eastern prices to warrant the San Francisco establishments putting in the special machinery required.

* * *

WILLIAM BROMLEY, who died at his home in Bloomfield, N. J., on the 17th inst., was one of the most experienced marine engineers in the United States. Mr. Bromley was born in this city seventy-two years ago, and learned his trade as a machinist at Dunham's Machine Works. For many years he was Superintendent of Pease & Murphy's Works, and as such built many of the engines used on Federal men of-war during the rebellion. In 1868 he went to the Quintard Works, foot of East Twelfth Street, and ten years ago he was admitted to the firm. During the past year Mr. Bromley was in feeble health, but he maintained a keen and lively interest in the construction of the engines of the '*Concord*' and the '*Maine*', and was freely consulted as the work progressed.

* * *

Mr. Jacob Cochrane, of Hull City, South Dakota, claims some important advantages for the device he has recently patented for propelling vessels. The invention, briefly stated, provides a series of buckets used in connection with endless chains and chain wheels. The buckets, as soon as they touch the water, instantly operate to propel the vessel ahead or astern, and the whole power of the engine is utilized. This is not true of the circular wheel or screw. If Mr. Cochrane's claim should prove to be well founded, his invention will be valuable, since it will save fuel and reduce friction to the minimum. —*Marine Journal.*

It seems to us that it is about time that the Government stopped issuing patents on this thing; it is one of the oldest forms of propulsion, and not one is in use anywhere in the world commercially—for the simple reason that it is inefficient.

* * *

IT is reported that the electric lighting companies are preparing to increase the cost of incandescent lights. Unless some substitute for platinum can be found, this advance must surely follow. In each sixteen-candle-power lamp there are from four to eight grains of platinum. If six grains are taken as the average, one ounce will be used in eighty lamps. Based on the increased use of incandescent lights within the last two years, it is safe to assume that the demand for sixteen-candle-power lamps, or their equivalent, in the year 1891, will be 10,000,000. This means a demand for 125,000 ounces of platinum, which, at the present price, $17 per ounce, will amount to $2,125,000. The probable income from these lamps at the present rate of toll will amount to about $6,000,000, while the cost of one item of their .composition alone is one-third of the total income. Platinum is going up all the time, and a fortune is in store for the man who finds its substitute in the making of incandescent lamps.

* * *

THERE are now building at the Harrison Loring Works in Boston three new steel and iron composite lightships, to be stationed along the coast between Boston and Savannah. Several new vessels in all are to be built within a year and a half, those building at Boston being known as Nos. 47, 48, and 49. When completed they will cost about $70,000 each. The first vessel will be stationed at Sandy Hook, to replace the old one that has been there so many years. The following are its dimensions: Length, 112 feet; depth, 12 feet 8 inches; breadth, outside, 27 feet 8 inches. The ship is to be built of steel frame and plates sheathed with wood to prevent rapid fouling. There will be four steel collision bulkheads. The wooden keel will be of yellow pine, and the false keel of white oak. As the sheathing is put on, tarred felt is to be put between it and the bottom plank, and fastened with four-inch composition spikes. There will be two lantern masts 67 feet high and 16 inches in diameter.

The Sandy Hook vessel is to have the first revolving light ever shown on a United States lightship. Forty-four of the sixty-two lightships in the British service are now fitted with revolving lights, but the project has never before been attempted by the American Lighthouse Board.

* * *

THE Chief of the Bureau of Ordnance says, in his report:

"The plans of the Fortification Board included forty-four 16″ guns, to defend ports of the first importance. The general ground upon which rests the necessity for the procurement of guns of this calibre is, that the land defenses shall possess guns not only equal in power to any that the attack can bring forward, but that they shall endeavor to hold this superiority in this respect over the attack. Thirty-six of the fourty-four 16″ guns recommended by this board are for the defense of the three chief ports, New York, San Francisco, and Boston. These guns are to be mounted in pairs, in turrets occupying low and exposed sites, and commanding the principal water approaches to the port. Owing to their great cost but few of these turrets will be erected, and their armament should be of the heaviest calibre of guns attainable, to justify their expense and secure for them an offensive power commensurate with the importance of the position they will occupy. The length of the proposed 16″ gun is about 49½ feet, the length of bore, 35 calibres, and the weight 125 tons. It will fire a charge of about 1,000 pounds, with a projectile of over one ton in weight. The estimated muzzle penetration in iron is about 3 feet, and the maximum range about 15 miles."

* * *

IT is said that the new gun lathes being furnished the War Department are wholly unsuited for heavy ordnance work. The makers of the lathes are the Pond Tool Works, of Plainfield, N. J. During the past session of Congress $400,000 was authorized for the construction of heavy cannon for seacoast defense purposes. Nearly all the guns for the Atlantic seaboard are to be built at Watervliet. In order to render the arsenal capable of undertaking the work, the War Department found it necessary to have constructed seven big gun lathes. Bids were invited, and many prominent machine makers entered into the competition. Among the number were the Pond Tool Works and William Sellers & Co. The latter firm bid $60,000 for each lathe, or $350,000 for the whole contract. The Pond Tool Works bid $30,000 on each lathe, and being the lowest bidder, received the contract. The bids in each instance, save one, were on plans drawn by the War Department. The single exception was the bid of William Sellers & Co. This firm bid on plans of its own. The War Department plans are said to be primarily the plans of Lieut. Gordon, of the Ordnance Corps. They were adopted by the Secretary of War. Three heavy guns have already been turned on one of Gordon's lathes. None have ever been turned on one of William Sellers & Co.'s lathes, yet the Philadelphia firm have protested in a written communication to Secretary Proctor against the adoption of the lathes being built in Plainfield. In order to satisfy himself more thoroughly that Lieut. Gordon's lathe warrants adoption by the War Department, Secretary Proctor has secured the services of Mr. Horace See, the naval architect and marine engine builder, and Mr. John Fritz, manager of the Bethlehem Steel Works, as experts. These two gentlemen understand the strength of metals and the efficiency of different types of machine tools. They will personally inspect the lathe now in operation at Watervliet and report their opinion.

WHEN it is considered that color as relating to any one individual is simply different effects produced by different causes upon the nerves of the eyes, it becomes apparent that the same causes may produce different effects. In this respect the nerves of the eye are not dissimilar from those of the ear, which can discriminate such slight variations of sound that when a number of instruments play as nearly as possible the same sound, the trained ear will distinguish a single one, and even one at will, to the exclusion of all others. Thus the eye may be trained to select any shade of color quickly, and the same is true with regard to forms. —*Vivarlas.*

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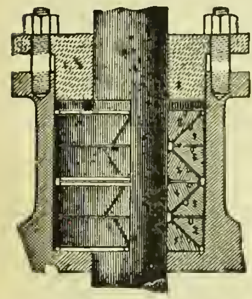

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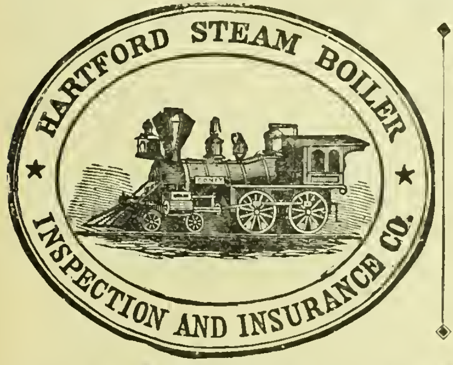

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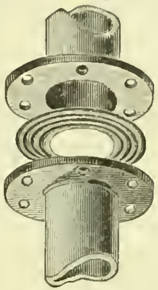

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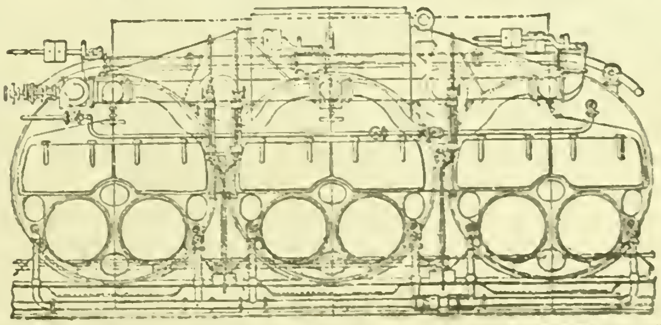

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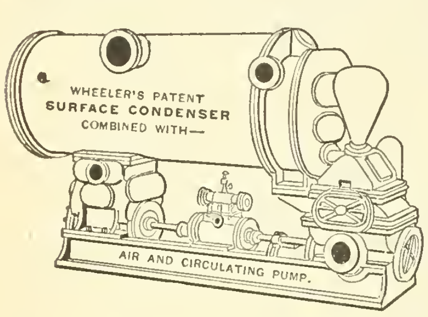
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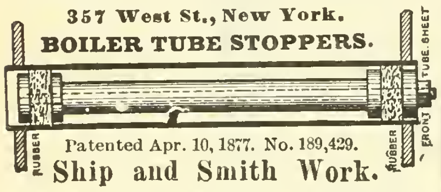

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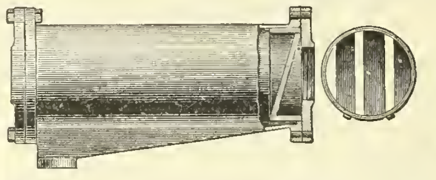

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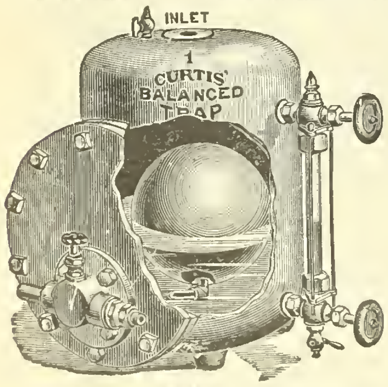

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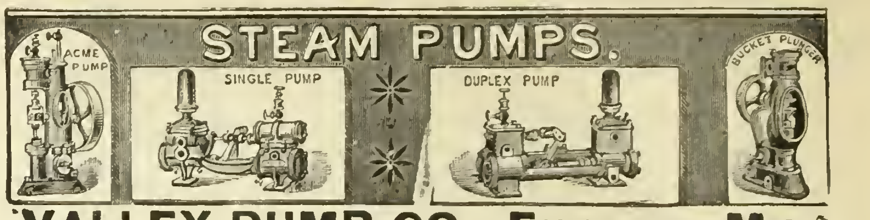

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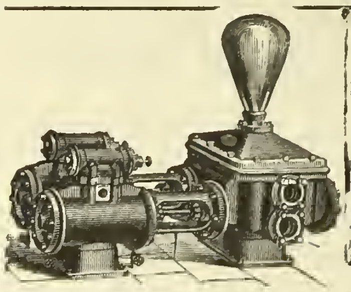

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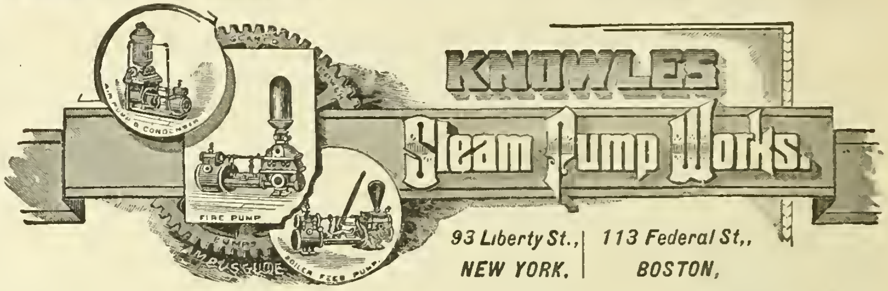

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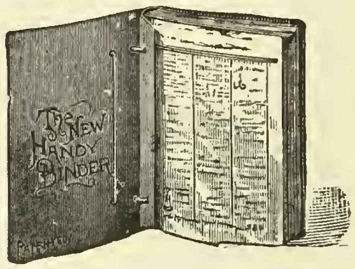

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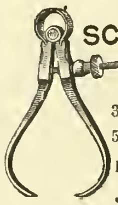

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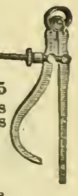

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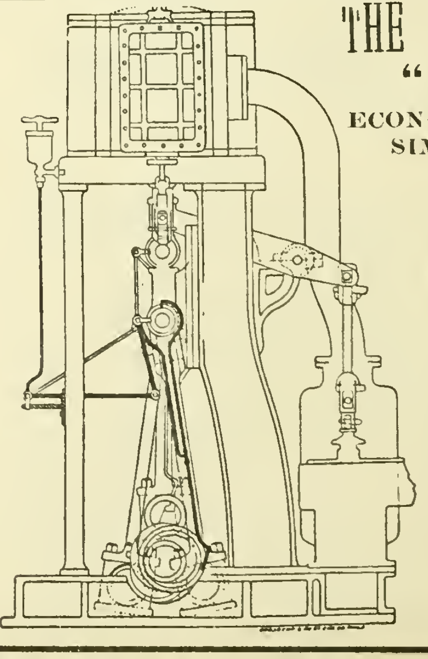

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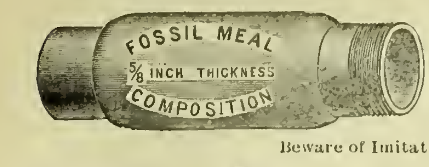

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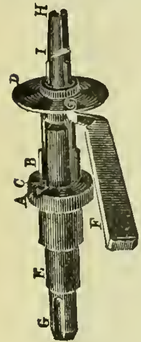

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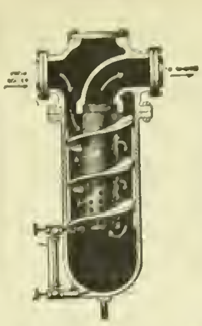

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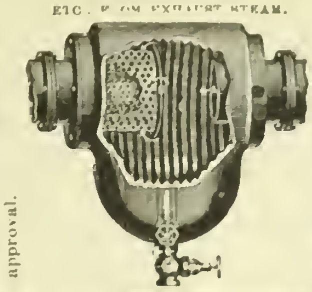

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SIR:—We have respectfully to report, that in accordance with the endorsement on the letter of the Bureau of Steam Engineering, dated July 10th, 1889, and numbered 1964 J. J., we have tested the Lubricating Balls made by the Colgan Manufacturing Co., by using them for the internal lubrication of the Machine-shop Engine of this Yard, during all the working days since the 24th of December last, until the 15th of the present month, or forty-five days. For the first five days, four balls per day were used; in the next ten, three per day; and since then, only two per day. They were fed to the steam chest, a quarter of a ball at a time, through a common grease cup, having a cock below it and covered with a screwed cap. These balls are put up for transportation in wooden boxes that hold a gross each, the outside dimensions of the boxes being ten inches by ten, by seven and a quarter inches deep. They are, therefore, easy to handle and to stow and care for on shipboard. Each ball is wrapped in tissue paper, to prevent adhesion under moderately high temperatures. They liquefy at about 110 F. They have no objectionable odor, either in the solid or liquid state. We have the assurance of the manufacturer, in which he expresses a willingness to support by affidavit, that they contain neither animal or vegetable matter. They are sold at five dollars per gross. On the 16th instant, the interiors of the cylinder, valve chest and heater into which the engine exhausts, were examined. All the wearing surfaces were found in excellent condition, bright, smooth and clean. Nowhere in the cylinder or chest was there any accumulation of grease or dirt. The heater had not been cleaned for a long time, but there was no appearance of recent deposits of grease. The anti-frictional value of this lubricant could not be established by this method of test, but, to the unaided senses, the appearances were in its favor. It would seem, therefore, that, at a cost of less than seven cents for and eight-hour day, the internal wearing surfaces of a twenty-inch cylinder, including a main and cut-off valve (both sides), the piston of which, actuated by steam of an initial pressure of forty pounds, had a speed of about 540 feet per minute, were well and efficiently lubricated for the time of the test. We, therefore, respectfully recommend these Lubricating Balls for purchase and use in vessels of the Navy wherever they are required. Very Respectfully,

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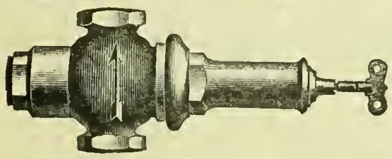

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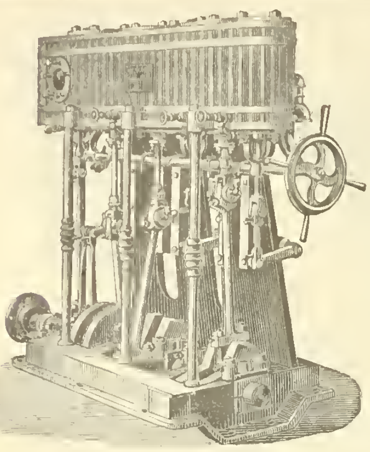

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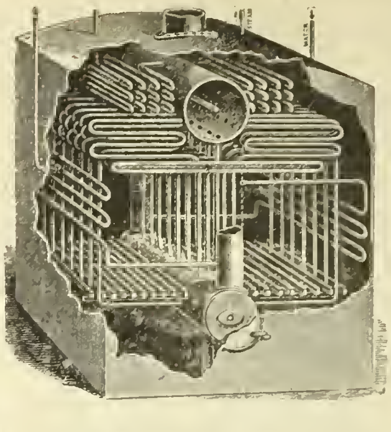

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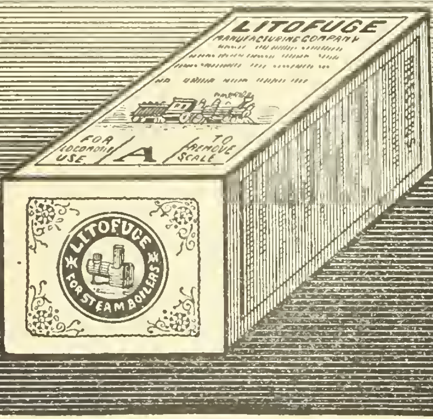

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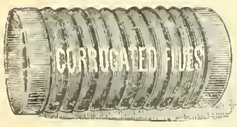

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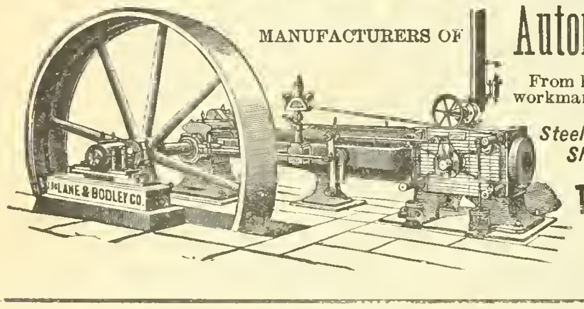
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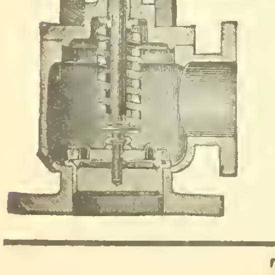

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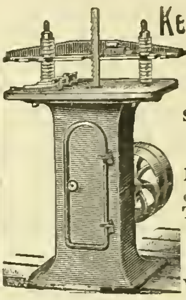

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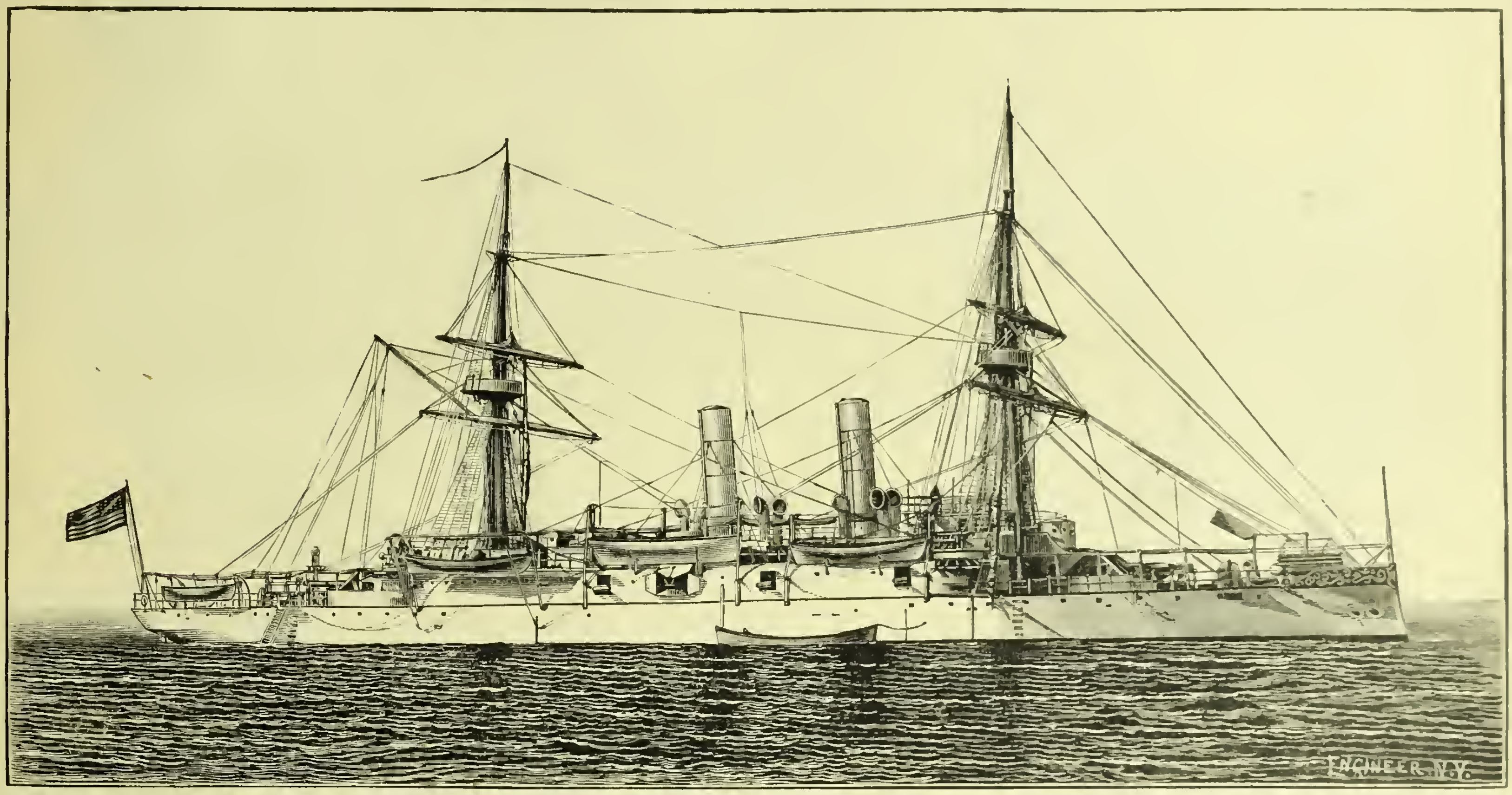
THE NEW NAVY, No. 3.

THE '*Atlanta,*' U. S. N. CRUISER.

OUR engraving in this issue represents the '*Atlanta,*' U. S. N., steel cruiser. This vessel and the '*Boston*' are twins, and exactly alike externally and otherwise, so a view of one of them is all that we shall give. These vessels have a central superstructure, and but one deck. They are 283 feet over all, 42 feet beam, mean draught 17 feet, and a displacement of 3,189 tons. The protective plating over the engines and boilers is $1\frac{1}{2}$ steel. The engines are three cylinder compound, horizontal, back-acting type, with cylinders as follows: h.p. 54″, low-pressure 74″ with 42″ stroke. These are driven by eight horizontal, return tubular boilers, 11′ 8″×9′ 9″ long. The '*Atlanta*' is a very fast ship for her power per ton of displacement. On her trial trip she made an average of 15.43 knots for six hours on a horse-power (indicated) of 3,356; her greatest speed was 16.33 knots and an average horse-power of 3,511. The coal per h.p. per hour was 263. During the recent cruise of the White Squadron the '*Atlanta*' proved herself capable in all respects and she, as well as the '*Boston,*' is a desirable addition to the fleet of new ships. She was built at Chester by John Roach & Sons in 1885-86.


ENGINEER N.Y.

◆

A POOR fellow was recently scalded to death at the Montpelier electric light station as he attempted to blow the large boiler out. He opened the valve wide and the pressure turned the elbow so that the contents of the boiler were emptied into the room and on to him. The accident was caused by his own carelessness, says the *Dispatch*, but this is incorrect; it was caused by the carelessness of the man who connected the pipe so loosely that pressure would turn it.

A RECENT number of the *Railroad Gazette* gives engravings of four specimens of riveting done under different conditions in order to ascertain the thickness to which plates can be piled and still have the holes completely filled by rivets. These experiments were made for Mr C. W. Buchholz, by the Union Bridge Company, at Athens, Pa. Two specimens were made—each of nine plates. The two longest plates in each specimen were $20\frac{1}{2}$ in., and the short plate was 3 in. All were 5 in. wide. The two long plates in each specimen were $\frac{3}{4}$ in. thick; all the rest were $\frac{5}{8}$ in. The height of the pile, therefore, was $5\frac{7}{8}$ in., the length $20\frac{1}{2}$ in., and the width 5 in. Two lines of rivet holes were punched lengthwise of the plates and 3 in. apart, and the rivets were spaced $1\frac{1}{4}$ in. center to center, except the two longest pairs, which were $\frac{1}{2}$ in. center to center. In each specimen one line of rivet holes was punched $\frac{7}{8}$ in. in diameter, and reamed to $\frac{15}{16}$ in. The other line of holes was punched $\frac{15}{16}$ in., and not reamed. All rivets were $\frac{7}{8}$ in. diameter. In one specimen the rivets were driven by machine, and in the other by hand. The conclusions arrived at are that the limit of thickness which can be riveted and have the rivets properly fill the holes is about five times the diameter of the rivet; that holes for hand driven rivets should be reamed smooth when more than two plates are used. The proper thickness, however, would probably not be increased in direct proportion to the diameter of the rivet, owing to the greater power necessary to upset the rivet as its diameter increases.

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OVERCOATS for boys of 18 can be bought in this city for $1.80. They are made of "cassimere."

◆

SEND for our Circular to Canvassers.

STEEL CASTINGS.

TOUCHING the matter of steel castings—so-called—and the experience the Government has had with them, it is interesting to hear the testimony of Engineer-in-Chief George W. Melville, U. S. N. He says in his report for this year:

"Touching the defects in steel castings, which has so troubled the department: "Reports have been received of failure after failure to produce sound castings of comparatively simple form and moderate weight and design, and patterns have been altered in the hope that better results might be obtained with change of form. In many cases the changes have availed nothing, and after long delays application has been made to use forged steel or cast-iron; in others, when the dimensions have been increased to nearly what would be required for the latter metal, sound castings have been obtained. The truth of the matter is that the manufacturers have not kept pace with the demands of the consumers, and unless there is very great improvement in the making of steel castings in a very short time a return to cast-iron will be inevitable, since it is evident that the only reason for using the more expensive material is that the weight of the parts may be decreased in the proportion of its greater strength."

This is the experience of many private firms. The average steel casting—so-called—is not so good as good malleable iron.

◆

STEAM is thick or thin according as it is hot or cold.—*The Engineer.* "Is cold steam sold in "briquettes"?—*Trade Review.*

Steam forms at all temperatures, dear friend, from zero up. Look out on a pond some cold morning and you will see cold steam. It is very thick. Were you ever in a fog? That's cold steam, too.

◆

THE next issue closes our business year, and friends who intend to favor us with their support another year are respectfully requested to remit as early as possible; by doing so they greatly facilitate matters and avoid non-receipt of the first issue for 1891.

NORTON'S UNSINKABLE SHIP.

Captain Frank Norton, of this city, claims to have invented an unsinkable ship, and will test his invention in a 58 foot steam yawl by crossing the Atlantic at once. There will be ten persons on board, the captain's wife and her niece, Chief Engineer Crawford, and one assistant, and there will also be a sailing master, two seamen and two stewards.

The boat has a double bottom, divided into six ballast compartments lying on each side of the keel. They are solidly framed in and cemented, and they are made of galvanized iron. Close to the keel in the bottom of each chamber is an opening fitted with a lead sleeve, which is watertight. The weight of the boat drives the water through these openings, and fills the chamber, the air being driven out through the main deck automatic tubes. The boat, therefore, floats on the inner bottom. It carries a small surface condensing compound engine, built by Riley & Cowley, South Brooklyn, N. Y., whose cylinders are $5\frac{1}{2}$ and 10 inches in size. There is a four-bladed propeller 34 inches in diameter, with a 34 inch pitch. Under a pressure of 120 pounds of steam, developing 30 h.p., the wheel will make nearly 250 revolutions a minute. One ton will last, Capt. Norton says, nearly two days. The bunkers will hold a thirty-day supply. The dimensions of the boat are: Length, 58 feet; beam, $12\frac{1}{2}$ feet; depth, $6\frac{1}{2}$ feet, with a displacement of 41 tons. There is a thirty-five day supply of provisions for ten persons on board, and 250 gallons of water in the tank. The boat has a distilling machine. The pilot-house and both hatches are solidly built into the oak frames of the boat, and cannot be washed away.

In the event of an accident to the machinery the little vessel can carry enough sail to drive her at a ten-knot gait. There are two little lifeboats, both constructed on the Norton lifeboat principle, and like the larger boat, Capt. Norton says they cannot be capsized by ordinary waves Capt. Norton will effectually demonstrate, he thinks, the superiority of his type of lifeboat.

◆

An interesting trial of the comparative merits of the Ward water tube boiler (American), and the Thornycroft water-tube boiler (English), showed the superiority of the former. So far as fuel is concerned the advantage is with the Thornycroft boiler, which evaporated a greater weight of water per pound of coal than its rival. When the relative efficiency of the boilers per ton of weight is considered, however, the advantage is on the other side, as shown by the following data, based on weights and dimensions: Horse-power per 1,000 square feet of heating surface, at 20 pounds of water per horse-power—Ward, 430.5; Thornycroft, 275.5. Weight of boilers without water—Ward, 11.84 tons; Thornycroft, 9 tons. Weight of boilers with water—Ward, 13.85 tons; Thornycroft, 11 tons. Horse-power per ton of boiler and water, under conditions of trials—Ward, 76.88; Thornycroft, 61.38. On these trials the Ward boiler made much the better showing as far as efficiency per ton of weight is concerned, and as the chief reason for adopting coil or tubulous boilers is to economize space and weight on shipboard, the advantage is regarded by naval engineers as being on the side of the Ward type. It is probable that as one of the results of this comparison the Ward boiler will be adopted in the department's design for the 750-ton torpedo cruiser.

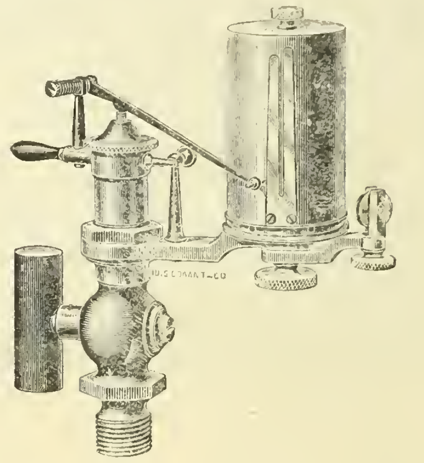
◆

The Directors of the New Haven Steamboat Co. have been arranging for a new steamer, and have recently examined plans therefor. It is to be built of iron, with twin screws, and is designed especially for speed, safety and comfort, and will make the trip to New York in less than four hours.

THE IMPROVED ARC INDICATOR.

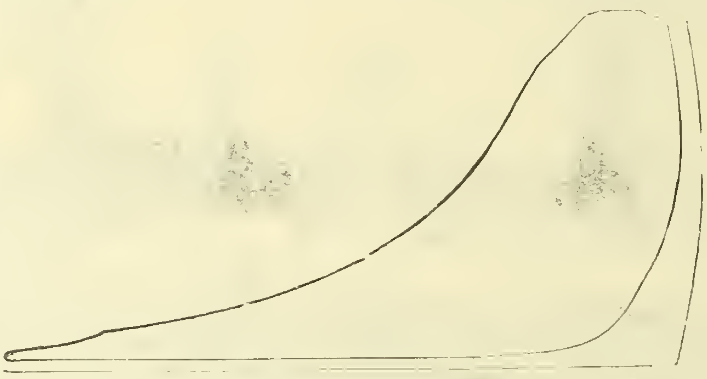
The Arc Indicator is constructed on scientific principles in the simplest manner possible, with a view of placing on the market an instrument that can be depended upon as absolutely reliable in every particular, and at a price so low ($25) as to come within the reach of every working engineer. This is accomplished by giving the pencil point an arc movement instead of a parallel motion, in which so many minute joints and so much delicate workmanship is necessary. It is a well known fact that so long as the pencil moves up and down in the same path, it matters not whether this path be straight or curved so long as the height due to the pressure is reached. The arc motion offers the simplest form of accomplishing this, as it requires only a single straight arm lever, supported from a central bearing, with no possible chance for any bind to appear from the pressure put on the pencil arm while taking the diagram.

We show a card taken with the indicator, and it will be observed that the admission line is curved, but by drawing the arc line beside it when on the drum, by raising the pencil arm with the finger, the engineer has the card as though squared, and with this arc can note more readily all the points he desires; for instance, whether the admission is parallel with the arc or not, it will indicate if the valve is late or early, and the point of compression commences is noted by the distance from the arc line.



The theoretical expansion line is laid out as ordinarily, but by striking arcs with the dividers, instead of drawing straight lines with a straight edge and square. The area of the card, from which the power is measured, is not affected by the arc motion, as all horizontal distances are just the same as in a straight line card, and like a triangle, depends for its area only upon the length of base and altitude.

This indicator has been upon the market for two years, and has met with great success at the hands of engineers, and has improved in detail from time to time, until now it has reached a high degree of perfection, and will record the action of steam in the cylinder of an engine up to the highest speeds more accurately than any other indicator. The drum is made as light as possible, with a bearing at both ends; the drum spring is ground concave on the sides to avoid all frictional resistance in the drum. The groove for the cord is so arranged that there is but one turn of the cord on the drum, preventing the distortion that appears when the cord runs double. The pistons are turned to a tight fit, and made to free themselves to the proper working fit by running them under steam at a very high speed. The springs are provided with heads that take a firm hold on the outer coils, leaving nothing but the free coils to do the work; these coils are ground in such a manner that the spring will stand compression to its fullest extent without showing any tendency to bind sideways. The piston rod can be lengthened or shortened by an extension screw, to raise or lower the atmospheric line, and this can be done while the indicator is in motion. The pencil arm is kept in contact with the piston rod by the auxiliary spring, which removes every possible chance for black lash to appear in the instrument. The tension of the spring can be changed for any speed without in any way affecting the number of the spring.



The indicator is extremely delicate in quickly answering each change in pressure, producing a very smooth expansion line, without oscillation, and even indicating the slight fall in pressure due to condensation at the junction of compression and admission lines, as may be seen in the card shown. Three springs are furnished with each indicator, and can be changed, with no joints or pins to disturb; also scales, cord, leads, cards, etc., packed in a highly polished cedar case, together with a treatise of 88 pages, containing simple and complete directions for attaching and using the instrument, reading the diagrams, computing the horse-power, steam consumption, etc., of both simple and compound engines, laying out the theoretical expansion line, and making all the calculations necessary in indicator practice. Address Hine & Robertson, 45 Cortlandt Street, N. Y.

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WATER MOTORS.

In a paper in the Michigan *Engineers' Annual*, M. E. Cooley describes some tests of water motors, which show that while the efficiency of these machines is higher, averaging about 45 per cent. of the energy of the water used by them, their capacities are very much overrated by the makers. A 30-inch double motor, rated at from 8 to 12 h.p. for a water pressure of 75 to 150 pounds per square inch, was tested under a pressure of 83 pounds, and in four tests gave a maximum of only 2.14 h.p. The radius of the brake arm was $5\frac{1}{4}$ feet.

The calculated total horse-power of the water used, adopting a coefficient of discharge of the nozzles of 0.8, was 4.73 h.p., and the efficiency of the motor at the maximum power developed, 2.14 h.p, was 45.2 per cent. Another make of motor of about the same size as the 30-inch, with a single $\frac{5}{8}$-inch nozzle, should give about 5 h.p., under a pressure of 83 pounds per square inch. Calculating the total amount of water used from the head and the area of nozzle, and using a coefficient of discharge of 0.8, the horse-power of the water itself is only 4.2 h.p., which, multiplied by 45 per cent. efficiency, gives only 1.90 h.p. as the horse-power of the motor, instead of 5, as rated. The amount of water used for any one of these motors doing considerable work is very large. The double motor tested consumed at the rate of 2735 gallons per h.p. per hour It therefore would appear that, except for very small powers, the water motor in its present form is not likely to be used to any great extent. Water motors for considerable power, such as the Pelton water wheel, are used on the Pacific slope under enormous head. With the special form of bucket known as the Pelton, an efficiency of over 85 per cent. is claimed to have been reached.

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If I turn to the literature of the screw propeller—and I think I have read most things that have been written about it—I find no two authorities agree as to what a propeller does to water or water to a propeller. It is all a matter of assumption. I shall only be too happy to get out of the region of surmise—I have quite an open mind. After years of study and observation I have been entirely unable to formulate any theory of the screw propeller; the best practice of the day seems to be based on empirical rules. All the resources of mathematics have, up to the present, been unable to give a means of determining beforehand what is the best screw for a new ship. Thus, the '*City of New York*' has propellers now which are very different from those with which she started. If we were to walk through the steel works of Messrs. Vickars, of Sheffield, we would see the patterns of propellers for all the crack steamships of the day, and we would be surprised at the difference between them.—*Cor. London Engineer.*

◆

The wild statements made by flying machine designers will not bear scrutiny. One of the latest schemers says his air ship will move at 200 miles an hour. Supposing him to have a motor capable of driving a screw 20 feet diameter and 20 feet pitch at 600 revs. per minute, which is the utmost practicable speed for a steam engine in such work, the screw itself will only make 136 miles per hour without losses by slip.

"Competition is so active," says the shoddy maker of anything, "that we cannot live unless we scamp," and that is the reason advanced for doing bad work and using bad material. This is merely open admission that shoddy goods have really no market value, but must be sold for whatever they will fetch. Makers of standard goods of every class, whether machines or anything else, do not put forth such pleas as those mentioned above. They make good work and affix a price to it; if this man does not buy that man will, and they look for that man until they find him. There will always be a demand for inferior goods of all kinds. Human nature is so constituted that many prefer the immediate cent to the future dollar, and if the demand exists it will be filled. Adulterated food products are common in the market, and no sort of legislation can exclude them, and the same is true of machines, boilers, etc. It is not because competition is so active that the standard is lowered, but because the maker confesses by his prices that suspicion rests upon the quality of his work.

◆

There are more people who believe Herman Melville dead than there are those who know he is living. And yet if one chose to walk along East Eighteenth Street, New York City, any morning about nine o'clock, he would see the famous writer of sea stories—stories which have never been equaled, perhaps, in their special line. Mr. Melville is now an old man, but still vigorous. He is an employee of the Customs Revenue Service. Forty-four years ago, when his most famous tale, "Typee," appeared, there was not a better known author than he, and he commanded his own prices. Publishers sought him, and editors considered themselves fortunate to secure his name as a literary star. And to-day? Busy New York has no idea he is even alive, and one of the best informed literary men in this country laughed recently at my statement that Herman Melville was his neighbor by only two city blocks. Talk about literary fame! There's a sample of it.—*Buffalo Courier.*

◆

There is time to earn $25 yet, before Christmas, by canvassing for The Engineer.

ENGINES OF THE 'HYGEIA.'

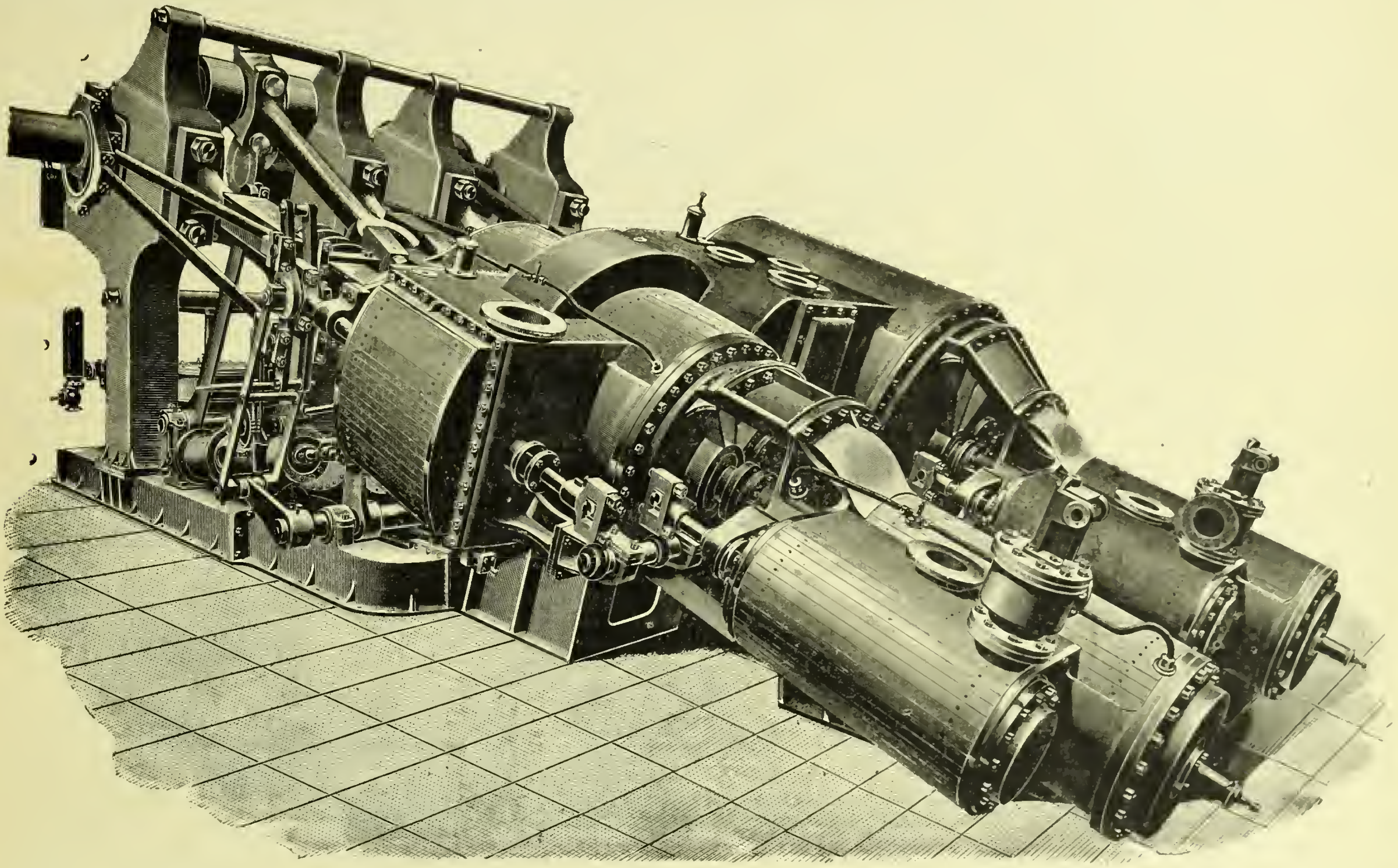
The engines of the '*Hygeia*' were constructed by Messrs. Rankin & Blackmore, Greenock, Scotland. They have Rankin's patent "disconnective" triple-expansion principle, specially designed for high-speed river steamers. They are of the diagonal direct-acting type, and have two high-pressure cylinders, each 28 in. in diameter behind an intermediate and a low-pressure cylinder 56 in. and 86 in. in diameter respectively, with a stroke of 66 in. There is only one set of stuffing boxes between each pair of cylinders, and ample space has been provided for the removal of the intermediate and low-pressure cylinder covers, which, in addition, have been fitted with manholes and doors for examining the pistons without disturbing the covers. All the pistons have deep cast-iron packing rings held up to the bore of the cylinders by short spiral steel coils. The two-high-pressure cylinder valves are of the piston type principle, and the low-pressure is double-ported. The valve motion consists of the double-barred link type, and is actuated by one of Brown's steam and hydraulic reversing engines, the starting lever for which, along with the lever for the throttle valves, is brought to the main deck platform, and constitutes a particularly simple arrangement, as in consequence of there being two high-pressure cylinders, no starting valves are required, and it is impossible for the engines to stick on the dead centers, so that prompt handling is always assured.

The diagonal framings are wrought-iron, bolted to brackets cast on the cylinders with round solid flanges, attached at the other ends by T heads to the main bearing framings, which are of cast-iron and box section. These are firmly bolted to the sole-plates, and bind the whole structure rigidly together.

There are two single-acting air pumps, which, in conjunction with two sets of feed and bilge pumps, are worked from the piston-rod crossheads by means of drag links and bell-cranks, so arranged that the various buckets and plungers help to counterbalance the weight of the cylinder, pistons, etc. On her official trial the absence of vibration in both hull and engines, and the exceptionally smooth working of the latter, were the subject of remark.

The forced draught arrangement is of the closed stokehold type. There are six steel boilers of the "Navy" type, constructed for a working pressure of 140 lbs. to the square inch. They are covered with composition and galvanized sheet-iron, and lie beneath the main deck. The smoke boxes and funnels are double throughout, so as to reduce the radiation of heat, and an extra casing, 7 ft. high, has been fitted round the funnels on the promenade deck on account of the warm Australian climate.

The '*Hygeia*' went on her official trial with the result that the average speed of 22.8, or fully 22¾ statute miles, was recorded, the best run being at the rate of 23⅓ statute miles, which places this vessel in the forefront of high-speed river steamers.—*Engineering.*



Whoever thinks the penny-a-liner is dead is mistaken. He is very much alive. In trying to say that a man sawed a plank off, he manages to get paid for all these words:

> "Are you all ready?" shouted Constructor Mintonye.
>
> "All ready, sir," came from the long lines of foremen on either side, fore and aft.
>
> Then the saws were put to work. B. Sweeney and David Watts cut the starboard sole piece, and James Petersen and James Brush severed the one to port. Down through the strong oak fibres went the teeth of the blades, until the end was reached. There was a pause. Fully two minutes elapsed before the narrow incision widened. Gradually, under the persuasive influences of a wedge, it stretched apart.

He could have told the story in two lines, but he would not have made so much out of his space. All the New York papers employ penny-a-liners.

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It is surprising to those who have not given the matter close attention, to see the interest taken in steam launches. The matter has been brought to our notice forcibly by the fact that we have published engines of this class for the past three months in great detail: it has resulted in a large demand for those issues, and is still in force. The small engines which have been shown in The Engineer are being built all over the country, by hundreds, we should say, if the assertions made by writers are proof.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

DISK CUTTING TOOLS, ETC.

Editors Engineer:

And now comes another "new" tool, known as "Martignoni's disk, cutting tool," which is being introduced by an English company, and claims to be patented! Well, there may be something about it which furnishes a pretext for some flimsy claim or other, as is so often the case with regard to machinists' tools and many other articles; but disk tools, substantially the same as those sold by the above company, but, in the writer's opinion simpler and better, have been made by American tool makers any time during the last twenty years. They are good, but they are not new.

Every once in a while some one patents a "new" invention, which consists substantially of some old and well known form of machinists' tool. This was the case with the straightway drill, which had been made and used by many machinists fully twenty-five years before it was patented. I made and used these drills for the Wilcox & Gibbs Sewing Machine Company in the year 1872, and with one of them drilled through eleven hundred inches of cast-iron without re-sharpening. The first one of them that I ever saw was made by Ed. Murphy, for the A. B. Howe Sewing Machine Company, in 1865, and Ed. did not claim it as a new invention at that time.

Charles H. Davids.

Davids' Machine Company, N. Y.

[This letter shows how doctors disagree sometimes. Mr. Davids is a machinist of wide experience, and he approves of disk cutting tools for metal. Some others of similar experience think that they are not worth shop room.]

CONCERNING LICENSES.

Editors Engineer:

In looking over my paper, The Engineer, I find that I have been a subscriber from March, 1881, and the good I have got from them I cannot express. They are my right hand support.

Will you oblige me by answering these questions: Are ocean licenses graded by tonnage? If a man holds a license for inland steamers of 2000 tons and has served on board ship as an assistant engineer, with recommendation from the chief can he get his license changed from inland to ocean steamers of the same tonnage?

J. T.

New Haven, Conn.

[This question is a difficult one to answer, for the laws relating to licenses of engineers are very vague. There are 37 grades, but none of them for tonnage, or style of engines; only the class of the hulls and in what service employed are designated. An engineer employed on a steam vessel of some of the grades mentioned, if the owner of the boat changes her trade or occupation, the engineer will have to change his license before he can technically act as engineer of her. There are, however, two grades, mentioned that might cover this question. One of them is in regard to engineers of ocean steamers; the other is for lake, bay and river steamers. There appears to be a distinction and a difference, and the engineer of a lake steamship could not by law act as an engineer of the same ship, engines and boilers, if the route should be changed from the lakes to that of the ocean.]

AN OPEN LETTER.

To the Engineers of the United States:

Your associations are meeting with success and prosperity that is gratifying to every well-wisher of the engineers. The objects for which they are formed are admirable. They educate, instruct and bring together many minds, whereby you exchange opinions which result to the benefit of all who are seeking to be enlightened. Now, has it ever occurred to you that while in your prosperity, you should prepare for the welfare of those who should be so unfortunate as to lose a limb, or meet with an accident which would prevent them from earning their living? Why not build a suitable home for the unfortunate? Have it centrally located, and founded on the broadest of principles, a home that would welcome every engineer who has had charge of an engine for a year or more, as you may decide. It is not necessary to go into details here. This is merely a suggestion, and pardon me if I intrude. No doubt every manufacturer and merchant of steam appliances would be pleased to contribute to such a worthy object, and the contributions which would come from your associations would build a suitable and comfortable home. Now, gentlemen, in your meetings debate, deliberate, and, what is more, act on this question. It is for you to decide, and thousands will wish you success.

New York. Alfred B. Jenkins.

ANSWER TO MR. C. AND OTHERS.

Editors Engineer:

1. Can you tell me why I cannot get my paper (ordered through a newsdealer) until—sometimes—a week after publication?

2. Also please tell me if you have missed publishing a number at any time this fall, as my old dealer said you did?

By answering the above, you will confer a great favor, and, as I don't suppose you want any compliments, I will close with another growl about my missed papers.

J. W. C.

Newark, N. J.

[1. The laziness of the newsdealer. The Engineer is always exactly on schedule time; never an hour late. It is always bulletined on the American News Company's board the day of publication. If the newsdealer does not get it, it is because he is a bad man. Missing numbers can be supplied from this office.

2. The Engineer has never missed one issue, or one publication day, since it was born, and never will while we are on it. Misstatements like the above are made to cover faults of newsdealers. All persons who have any trouble in getting The Engineer through newsdealers are invited to send directly to this office for their paper. Six months subscription is only $1. Missing numbers can be supplied at any time on receipt of price.—Eds]

NATIONAL MARINE ENGINEERS' BENEFICIAL ASSOCIATION.

To the Order Wherever Found, Greeting·

You are hereby officially informed that National Treasurer George Uhler has instituted Gulf Association, No. 84, in Mobile, Ala., at which time the following officers were chosen and installed:

Past President, Wm. B. Hagan; President, John Steeber; Vice-President, W. T. Corr; Conductor, M. H. Turner; Treasurer, D. H. Vernanille; Chaplain, R. Connelly; Doorkeeper, H. D. Snyder; Cor. Secretary, C. J. Cocklan; Fin. Secretary, J. N. Korf; Rec. Secretary, J. E. Carpenter; Representative, Wm. B. Hagan; Trustees—John Steeber, D. H. Vernanille, W. T. Corr.

Address of Corresponding Secretary, C. F. Cocklan, Mobile, Ala.

National President Galwey expresses the desire that each corresponding secretary shall transmit a letter of congratulation to Association No. 84.

James Henry Harris,
Chicago, Ill. *National Secretary.*

APPLY TO THE YOUNG MEN'S CHRISTIAN ASSOCIATION.

Editors Engineer:

Will you please answer in the columns of The Engineer where a technical school is, so that I can become a first-class engineer. I have served three years in a machine shop, and am now serving the fourth year.

J. Z.

New York.

[We do not know of any in this city. There is a course of lectures delivered weekly at the Young Men's Christian Association on the Bowery. Apply to the secretary.]

COAL ENDURANCE OF CRUISERS.

Unfortunately rigid truth does not always enter into official statements and figures, and it is much to be regretted that in the matter of coal endurance what is officially specified concerning the battle-ships '*Howe*' and '*Camperdown*' is not realized in actual service, and, as a natural consequence, the general public are misled. Each of these vessels are credited with a coal supply of 1,200 tons, and this quantity is put forward as being sufficient to enable them to cover 7,200 nautical miles at 10 knots. This performance is only theoretically true, being based either on results obtained from trials over the measured mile, or the four hours' run. Under forced draught the '*Camperdown*' when on her official trial realized a speed of 17.14 knots with 11,742 i.h.p., and a registered coal consumption of 3.26 lbs. per horse-power per hour. With natural draught the speed obtained was 16.3 knots with 8,622 i.h.p., the coal consumption being 2.11 lbs. per horse-power per hour. At a 10 knot speed the co efficient for coal consumption would fall to about 1.85 lbs., while the actual indicated horse-power to propel the vessel on her normal displacement at a speed of 10 knots, is at least 1,600, which means a daily consumption in propulsion alone of 31.71 tons. To this must be added the quantity used for driving auxiliary engines, etc., and for culinary purposes, which is at least eight tons per diem, and brings the daily drain on the bunkers up to 39.71 tons. Turning now to the '*Howe*,' we find that from her speed trials she is represented to be a little less extravagant in fuel at the maximum rate of speed realized, than the '*Camperdown*,' although at about 16 knots the reported figures differ very little, so that under like conditions of trim and displacement the coal consumption in the two ships at the reduced speed of 10 knots should be about the same. At a speed of 15.872 knots, with open stokeholds, the coal consumed by the '*Howe*' on her official trial was 1.99 lbs. per horse power per hour, with the engines developing 7,695 i.h.p., while under forced draught the registered coal consumption was 2 17 lbs. per h.p. per hour, the speed being 16.932 knots, and the i.h.p. 11,703. With a bunker capacity of 1,200 tons and a daily expenditure of 3,971 tons, each vessel would have a radius of action of 7,250 knots at a 10 knot speed. This for all practical purposes agrees with the Admiralty figures exhibited as the coal endurance of the '*Admiral*' class of battleship; but it is purely a smooth water deduction, and certainly theoretical, as was proved most conclusively during the cruise of the '*Howe*' and '*Camperdown*' with the hostile fleet during the manœuvres in August last. The former vessel, after steaming a little over 3,000 knots at a speed of less than 10 knots, ran short of coal in mid-ocean on the homeward voyage, and had to fall out of line to replenish her stock from the colliers following in the wake of Admiral Seymour's fleet. The '*Camperdown*'s performance was very little better, for, after steaming considerably under 4,000 miles at 8 knots, it was found, on her arrival at Torbay, that she had not sufficient coal left in her bunkers to admit of her steaming 1,000 miles at 10 knots.

BOOK NOTICE.

The Mechanic's Complete Library of Modern Rules. Facts, processes, etc., for the engineer, artisan, electrician, how to make a dynamo, latest information for twenty different trades, etc., etc. Laird & Lee, Chicago, Ill.

This is a sort of universal hand-book, containing a variety of misinformation on various subjects carelessly compiled; in fact, not compiled at all, but thrown together without sequence or connection. The bulk of the work consists of newspaper clippings uncredited and of unknown origin, except in a few instances; we recognize some matter which has been culled from The Engineer. Page 169, "*Points for Engineers*" says:

> "When using a jet condenser let the engine make three or four revolutions before opening the injection valve, and then open it gradually, *letting the engine make several more revolutions before it is opened to the full amount required.*"

It is not necessary to comment on this for engineers, but we may say to the publishers of the work that the above quotation is arrant nonsense, and would result in disabling the engine at once by getting the condenser hot. Similar instances abound throughout the work, and it needs careful revision by a competent person before another edition is published. The title page says: "Compiled by Thomas F. Edison, A. M., and Chas. J. Westinghouse." We do not know what this means.

◆

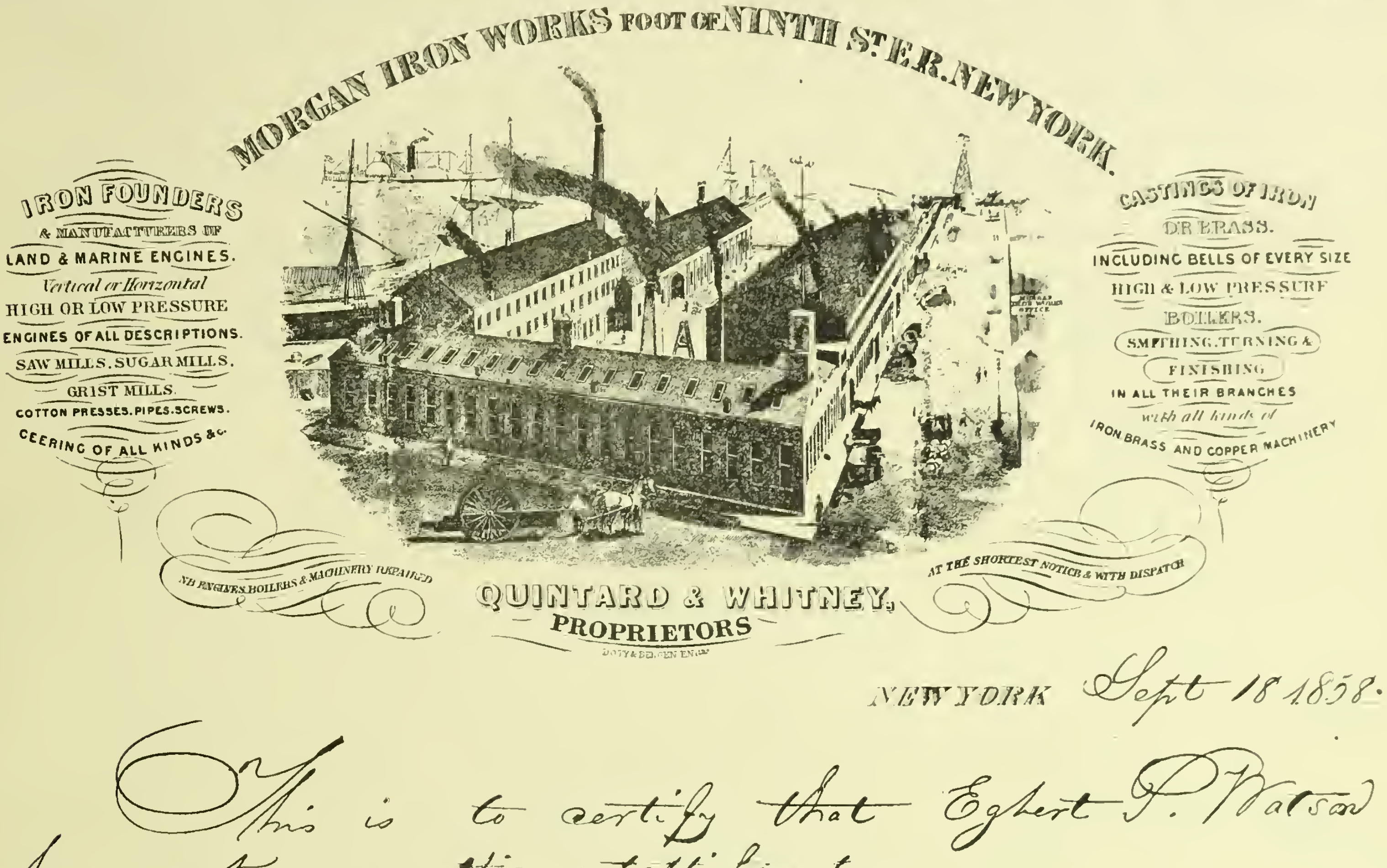
A possible explanation of the fact that only the clearance surface appears to influence initial condensation would be that, on first admitting steam to the cylinder, the clearance surfaces are almost instantly raised to nearly the temperature of the admission steam, and the cylindrical surface becomes heated in advance of the piston over a certain area which bears some definite proportion—for each engine—to the clearance surface, irrespective within wide limits of the point of cut-off. Thus, when by the forward motion of the piston fresh portions of the cylindrical surface are exposed to contact with the steam, these portions are already raised in advance to nearly the steam temperature, and no further appreciable transfer of heat to the metal occurs.

◆

It is good practice for students in technical colleges to work out results from conditions taken from daily work, and they should carefully preserve them; for in after life they won't have any opportunities for that sort of thing. The demands of business unfit the mind for comparison and determination of standards. The mechanical engineer of the future will be more occupied in figuring up costs than balancing natural forces

AN INTERESTING DOCUMENT.
1851—1890.

In rummaging over a lot of old papers recently, we came across the document photographed below, and it awoke so many recollections and brought to mind so many incidents, that we determined to publish it as a memento, for many of the friends who were with us then are with us now, and all through life have held out the right hand of fellowship and never drawn it back. This document is dated 1858, but seven years before that we began as an apprentice in the Morgan Iron Works. Time's tooth has bitten off one-third of the document, but enough remains to show its purport. We have not endeavored to "restore" it, as we easily could, for Miers Coryell is close at hand and could readily supply the missing portion, for his writing has not altered in the last forty years. The original text was as follows:



MORGAN IRON WORKS FOOT OF NINTH ST. E.R. NEW YORK.

IRON FOUNDERS
& MANUFACTURERS OF
LAND & MARINE ENGINES.
Vertical or Horizontal
HIGH OR LOW PRESSURE
ENGINES OF ALL DESCRIPTIONS.
SAW MILLS. SUGAR MILLS.
GRIST MILLS.
COTTON PRESSES. PIPES. SCREWS.
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CASTINGS OF IRON
OR BRASS.
INCLUDING BELLS OF EVERY SIZE
HIGH & LOW PRESSURE
BOILERS.
SMITHING, TURNING &
FINISHING
IN ALL THEIR BRANCHES
with all kinds of
IRON BRASS AND COPPER MACHINERY

NB ENGINES, BOILERS & MACHINERY REPAIRED AT THE SHORTEST NOTICE & WITH DISPATCH

QUINTARD & WHITNEY,
PROPRIETORS

NEW YORK Sept 18 1858.

This is to certify that Egbert P. Watson
has workd in this establishment
and journeyman for Several yea
workman, industrious and attento
he is familiar with Steam Engin
details I cheerfully recommend h
may desire his Services

Mier

> *This is to certify that Egbert P. Watson has served several years as apprentice and journeyman in these shops. He is a good workman, attentive to his duties, and familiar with steam engines in all branches. I cheerfully recommend him to all who are in want of his services.*
>
> Miers Coryell.

If the exigency arose we fancy we could live up to that "recommend" still.

◆

In our last issue matter was credited to papers it never originated in. This was caused by similarity of name. *The Journal Industry*, of San Francisco, was mixed up with *Industries, of England*. We regret this, for *The Journal Industry* is a live paper, which should be universally read.

The curious uncertainties of the law are well shown by a recent case which occurred in this city. A party rented a house and paid one quarter's rent, $230, in advance. Immediately it was paid, the alleged owner of the premises (who was a notorious fraud) got the payee out of the house upon a pretext, and locking the door, went off, refusing to return the money, saying the house was out of order. The fraud was arrested and cited before the Grand Jury, but the District Attorney sent a memorandum to the Grand Jury to the effect that the evidence was not sufficient to constitute a crime. There was no proof that the fraud did not own the house except her own admissions, which were insufficient in law. The money having been paid on a contract, the right to it was at once vested in the defendant, and she could not be convicted of larceny for refusing to return it. Her acts, however, rendered her liable to a civil action for breach of contract, but there was nothing on which an indictment could be found. The Grand Jury dismissed the case and Judge Fitzgerald discharged the fraud.

◆

Perhaps the cheapest labor in the known world is that of negroes who load guano ships. They get $13 for shoveling 100 tons. The pungent ammoniac dust is extremely irritating to the nostrils, throat, and lungs, rendering the shortest stay there unpleasant

◆

The next issue closes our business year, and friends who intend to favor us with their support another year are respectfully requested to remit as early as possible; by doing so they greatly facilitate matters and avoid non-receipt of the first issue for 1891.

Of coal tar colors, we have at the present time about 300 distinct kinds, of which about 30 give extremely fast colors, and an equal number or more give moderately fast colors. On the other hand, out of about the thirty natural dyestuffs usually employed, we may count ten as giving fast colors. We have therefore a total of about three times as many fast coal tar colors as we have of fast natural dyestuffs. A process of selecting the fittest has gone on in the past with respect to the dyewoods, and such is the sifting process now at work among the coal tar colors. The prejudice against the new colors is mainly due to manufacturers selecting colors on an inspection of their tint, irrespective of any experiments with regard to their fastness and suitability for any particular class of work. By judicious selection and careful experiment the good will gradually be distinguished, and both the manufacturer and the public will recognize that there is both beauty and permanence in the coal tar colors of to-day.—*Industry.*

◆

A scheme is on foot "to utilize the power of Niagara Falls," and extensive works are being undertaken to that end. From the published plans the Falls do not appear to be included, the water being taken from the Niagara River a long way above the Falls. It is a very obvious and not an unusual plan, but the success of the corporation will depend wholly upon the commercial aspect of the matter, as to whether it is a good point to manufacture at, and what facilities can be had for shipping products The mere fact that Niagara River is being used to turn turbine wheels will not have much weight.

THE ENGINEER.

FORTNIGHTLY. - - - $2.00 PER ANNUM.
Foreign Subscriptions, - - - - - - 2.50.
EGBERT P. WATSON & SON,
Editors and Proprietors,
150 NASSAU STREET, NEW YORK.

All communications relating to the business of the paper, and all remittances, must be made directly to the Publishers to receive prompt attention. Do not address THE ENGINEER, New York, as letters so addressed go to other parties.

VOL. XX. NEW YORK DEC 6, 1890. No. 12.

ADVERTISING.

Next to reading matter, per inch, each insertion..........$2.40
Second, third and fourth pages, per inch, each insertion...1.80

A discount will be made on long contracts. Cards may be displayed at will in all columns. No advertisements unsuited to our trade will be admitted. Make checks and money orders payable to **Egbert P. Watson.**

The circulation of THE ENGINEER covers all parts of the United States, and limitedly in Canada, Europe, and foreign parts.

☞The circulation of THE ENGINEER is absolutely and wholly a paid one.

To prevent misapprehension, we respectfully inform all friends that we do not open accounts on credit with any one for subscriptions; these are absolutely cash with order, to all and singular. We make no exception with publishers or agents, and will not open book accounts for small sums sent casually.

☞Papers will be discontinued at the expiration of the time contracted for, with due notice of same by postal card.

Entered at the New York Post Office as Second Class Matter.

WANTED.

An enterprising man, well-known to the manufacturers of the country, is needed to take charge of the advertising pages of THE ENGINEER. To one who can identify himself with the paper, an opportunity will be given to acquire an interest in it upon very easy terms. Communications by mail will receive prompt attention, and no confidence will be violated. Address

EGBERT P. WATSON & SON,
150 Nassau Street, N. Y.

NEWS AGENTS.

AMERICAN NEWS CO., Publishers' Agents	New York, N.Y.
American News Co	Denver, Col.
American News Co	Kansas City, Mo.
American News Co	Omaha, Neb.
American News Co	St. Paul, Minn.
Albany News Co	Albany, N. Y.
Baltimore News Co	Baltimore, Md.
Brooklyn News Co	Brooklyn, L. I.
Central News Co	Philadelphia, Pa.
Cincinnati News Co	Cincinnati, Ohio.
Detroit News Co	Detroit, Mich.
International News Co	New York, N. Y.
Montreal News Co	Montreal, Canada.
National News Co	New York, N. Y.
Newark News Co	Newark, N. J.
New England News Co	Boston, Mass.
New Orleans News Co	New Orleans, La.
New York News Co	New York, N. Y.
Northern News Co	Troy, N. Y.
Pittsburg News Co	Pittsburg, Pa.
Rhode Island News Co	Providence, R. I.
San Francisco News Co	San Francisco, Cal.
St. Louis News Co	St Louis, Mo.
Toronto News Co	Toronto, Ontario, Canada.
Toronto News Co., Clifton Branch	Clifton, Ontario, Canada.
Western News Co	Chicago, Ill.
Washington News Co	Washington, D. C.
Williamsburg News Co	Brooklyn, E. D.

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NOTICE.

A WORD of caution is necessary at this time in order to prevent papers going astray, or not coming to hand at all. In sending new addresses, friends will please write the names of persons and streets plainly, so that there can be no possibility of error. "Marion" is often written so that it may be either Merwin, Marius, Marvin, or Maria, and in many cases we can only guess at the proper name; so with many other names; we must have plain addresses to get papers to our friends.

DESTROYING CITY REFUSE.

COMPETENT observers have settled satisfactorily that the source of most diseases which afflict mankind have their origin in putrid matter of one sort or another, and this being admitted, it is of the greatest importance that the refuse of cities and large towns should be so disposed of that it cannot become a cause of offense. It is not a small matter to achieve this end, and very little has been done toward it. Most cities and towns of this country retain their filth as long as possible, and do nothing as regards its total destruction. It was thought that burning city refuse would accomplish the purpose in view, but it seems that even this is open to objection. In some cities in England crematories have been erected.

A destructor has been erected by the Hastings Corporation at a cost exceeding £4,000, and is described as proving highly successful. On the other hand, it is stated by some that the chimney emits a sickening smoke, which is very offensive. An improvement on this has been to attach a cremator to the cremator, so to speak, by which the gases arising from the burning refuse are led through a highly heated chamber, wherein they are so dessicated before finally emerging that they are innocuous.

The chief difficulty with all plans is the stupidity and objections of the taxpayers, for the cost of a crematory is considerable. The idea of paying out good money to prevent a bad smell (which is the only benefit many see), is too absurd to be entertained, and so the nuisances continue.

MATTER IN THE WRONG PLACE.

IF one were to ask the publishers of any of the great magazines and periodicals of the day if they aimed to cultivate and elevate the public taste, they would undoubtedly receive a reply in the affirmative, but if we examine the contents of these magazines we find a large number of tales and sketches which deal directly with the doings of crime and criminals. The language of the writers is not offensive; it is true, all is done decently and in order, so far as diction or descriptions go, but for all this the dialect, lives, incidents, and general happenings, not omitting descriptions of fights and the appearance of the combatants after the fight, are set forth in detail. *Harper's Bazaar*, a periodical which is published specially for ladies and families, has at this moment a serial by F. W. Robinson, which deals chiefly with English low life—convict life—and the career of a convict and his disreputable following. For months this dreary tale of vice and crime has been dragging along, and bids fair to drag on forever. *Scribner's Magazine*, also published by a well-known house, has a border ruffian story called "*Jerry*," which is of exactly the same type and character, with the exception that the scenes and fictitious personages portrayed are American. Surely this is not elevating the public taste or encouraging young people to lead decent lives. Sensational literature is perilous stuff to put in the hands of young people, and the last place we would expect to find it is in the periodicals mentioned.

◆

IT is pretty near time for some alleged trade paper to publish the history of the "Stourbridge Lion." Let's hear all about the old lion again—for the thousandth time. Some one never heard of it possibly.

AN ENGINEERS' RETREAT.

IN *Letters to The Editor*, this issue, Mr. Alfred B. Jenkins, of Jenkins' Bros., well-known manufacturers of this city, makes a suggestion which is an excellent one, and should have the hearty co-operation of all engineers' associations, whether marine or stationary, all over the country. We presume that Mr. Jenkins has in mind a retreat in old age for veteran engineers of good character, who may be disabled from following their calling by years, or permanent disability incurred by the nature of, or in performance of their duties, similar in its general features to the Sailor's Snug Harbor, on Staten Island. The engineers' institution is, we suppose, to be erected by the voluntary contributions of engineers and manufacturers, for, as Mr. Jenkins aptly says, they could render valuable aid to such a cause. The fund would also be increased by benefactions from time to time, so that it would soon be wholly self-supporting, and an independent corporation. It is needless to say that a retreat of this character would alleviate a great deal of suffering and privation in the lives of many who had not been able to get ahead of the world, and it would also be greatly to the credit of the engineers and manufacturers in the line of engineering. It would not be a charitable institution, in the full sense of the word, for an engineer who had contributed to the erection and maintenance of the Retreat, when young and able to care for himself, would be entitled to some of its benefits, if through the chances of life he became in need of them. We hope to see Mr. Jenkins' suggestion acted upon promptly, and will gladly do all in our power to aid it.

THE CORLISS ENGINE SERIAL.

OUR readers will perceive that we give in this issue the opening chapter of a series on the management of the Corliss engine. This is the article for which we offered $25, and we find that in respect to specific information and detail which will serve others at the same time, it is the best that has been offered. The writer of it is the chief engineer of one of the largest cotton mills in New England, and has had thirty years experience, so his teachings are worthy of attention. In the series will be found many original suggestions and plans which will reduce running expenses, and the treatment of breakdowns and the causes leading to them will receive attention. All persons, whether running Corliss engines at this time, or some other engine, should subscribe now and receive every article of this series. It will run through several numbers, and be illustrated where necessary.

◆

YOU probably did not know it, but you had a very narrow escape from being out of a job this winter. You, Mr. Man, with a permanent job, we mean. Through causes which are not made public, the Baring Bros.' world famous bankers, became involved, and were only saved from precipitating a general panic all over the world by other financiers coming to their rescue with $80,000,000 or $100,000,000. The danger is past now, but a fortnight ago the boldest financiers of the country held their breaths for a few days. Capitalists cannot afford panics; they are dangerous, and hurt everyone, because all are dragged down by them. But for timely aid one of the greatest financial panics of the century would have been precipitated last month. Let us all be thankful for what did not happen.

◆

THE truth is, says a writer, that there are no such things as trade secrets, and guard factories as jealously as we may, the journalist or engineer who wants to find out can easily do so. As regards the most minute details in the construction of ships and engines for war or commerce, there is nothing hid which cannot be revealed provided proper means are taken to obtain the information. Knowledge cannot be wrapped up in a napkin and buried in the earth.

ENGLISH vs. AMERICAN WORKMEN.

MR. DICKINSON is the secretary of an English concern in Sheffield. He seems to be a queer kind of man, judging by some remarks he made recently. Comparing English and American workmen, he says:—

> "The American workman is much more temperate; there is considerably less drinking. He also dresses well. In the smaller cities, at any rate, they have very comfortable homes. Taking them all round, they are intellectually of a higher class than the bulk of English workingmen. *This is due in some measure to the Americans having induced our best workingmen to go over there. In most works the managers and foremen, and the most skilful hands are Englishmen.*"

We think the English word for statements of the kind italicised is "taradiddle," when a man says things that are not so he tells a taradiddle, whatever that is. Mr. Dickinson is mistaken in his premises and deductions. In American works the foremen and hands are three-fourths American. In some few concerns which English syndicates have bought up there are English superintendents and English workmen, but these latter are of no use to us until they have forgotten their English ways and become Americanized. Much more work is done by American workmen in a given time than by English workmen. Beer is not allowed to be swilled at all hours. The working hours themselves are different; the customs of the country are different; the holidays are fewer, and all these things are sources of unhappiness to Englishmen who are new to this country. It is a horrifying thing to say to English ears, but American workmen can work all round English workmen, and work closer. Let him have time and tools enough, and an Englishman machinist can turn out a job as well as any one else. Good workmen are of no particular country; but the American workman is, as Mr. Dickinson says in the lucid portion of his remarks: "Taking them all round they are intellectually of a higher class than the bulk of English workingmen."

That settles it.

◆

WELL DONE.

A NOVELTY in securing publicity and reminding the trade world that they still exist has been issued by the enterprising and old house, the Mason Regulator Company, Boston, Mass. They sent us by mail a box about 24 inches square, which contained a sure enough wish bone, secured to a card, upon which was printed these words:

> Wish for Happiness.
> Wish for Health.
> Wish for Honor.
> Wish for Wealth.
> But be sure and wish for the continued prosperity of the Mason Regulator Company.

And on the other side.

> "We have no bone to pick with you."

This is true, for the bone was not only already picked, but polished when it came to hand. Enclosed with this unique reminder was the appended circular:

> "It has seemed best for us to reply at once to the many inquiries we have received in answer to Our Thanksgiving Circular, as to how we came by so many wish bones. We would say that the circular referred to is probably the most expensive one ever published. Every wish bone represents a whole turkey, and you will readily see that to procure the number of bones required to give each of our customers even one, it has been necessary for us to have had turkey constantly for the last several hundred days, which, though a very inexpensive diet during the summer, makes a large average taking the fall season into consideration. But to say nothing of the expense, while we had no objection to the first forty or fifty meals, even turkey became tiresome, and more than once it was with visions of delicious steaks and roasts that we persevered in our scheme to give our customers the Thanksgiving Souvenir of 1890."
>
> MASON REGULATOR CO.

This is an original idea in advertising, and as such is worthy of note.

◆

THE next issue closes our business year, and friends who intend to favor us with their support another year are respectfully requested to remit as early as possible; by doing so they greatly facilitate matters and avoid non-receipt of the first issue for 1891.

THE MANAGEMENT OF A CORLISS STEAM ENGINE. No. 1.

C. D. THURBER, BIDDEFORD, ME.

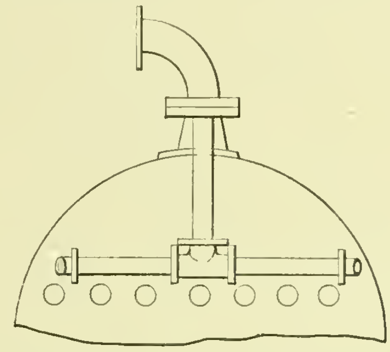
THE cotton manufacturing company, by whom I have been employed for the past 8 years, is located on one of the New England rivers, which furnishes very good water for steam purposes. We have one large battery of boilers in which the pressure is 100 pounds for the simple condensing engines, and in line with these there is a battery of six boilers, in which the usual pressure is 125 pounds for the compound engine.

All of these boilers are return tubular, with overhanging fronts, and are 60 in. diameter, with 76 tubes 3¼ in. diameter and 21 feet long. The distance from grate to shell of boiler is 24 in.

I am particular to give these dimensions for the reason that I have found them very good proportions, with the exception of distance from grate to boiler, which should be something more, on account of the gaseous nature of the Cumberland coal that we use.

We have a small independent steam pump connected to tanks, for weighing feed water, and other instruments for testing the evaporative efficiency of the boilers, and trying different kinds of fuel.

Numerous tests have proved that the best method of burning bituminous coal is the one mentioned in THE ENGINEER of Oct. 18, page 90, "*The Smoke Nuisance*," as the slow-firing method. I allow but three shovels full of coal to each furnace door at a time, and alternate from right to left hand door at each firing. This does not prevent all smoke by any means, but there is not an objectionable amount appearing at top of the chimneys at any time.



The method of coking the coal in front of the fire, I have found very objectionable when tried in connection with an evaporative test. The fireman cannot see the body of his fire and there are sure to be thin places where cold air rushes through; and besides this it is very destructive to the front of furnace.

Leaving the fire door open a little for a few moments after each firing reduces the amount of smoke, but gives a lower result of water evaporated on a week's trial. I have also carefully tried introducing air through perforated plates in the bridge wall. This appeared to promise success, judging by the appearance of the fire as seen through sight-holes on back end of boiler, but I found by my testing apparatus that this view of the fire was very misleading.

The best results will be found with moderately thick fires, and while burning from 12 to 13 pounds of coal per square foot of grate per hour.

I have met many engineers who seem to think that slow combustion means more perfect combustion. I have found the reverse to be true. A high firebox temperature, a clean boiler, and low temperature of uptake, is what is wanted.

All engineers who possibly can should have apparatus for weighing feed water and making evaporative tests, as the amount of steam used for power and other purposes is liable to considerable variation, and the weight of coal alone does not always give a correct result.

By careful trials one can readily find out what is best in any given case, and will undoubtedly find the unexpected sometimes, and thereby make a handsome saving in the coal bills. These tests should not be less than one week in duration.

I have found it best to leave the air passages in furnace doors open at all times, while burning bituminous coal. The draught is much better regulated by an automatic damper regulator than by hand.

My experience with shaking grates has not been very favorable. By a careful trial of one week, of one of the best rocking grates in the market, I failed to find any gain in economy of coal; in fact a slight reduction in pounds of feed water evaporated. This was probably owing to the reduced grate surface, as the maker put dead plates three inches wide on sides and back of furnace.

We have for a number of years used plain grates in sections about 6 inches wide and 21 inches long, air opening ½ inch, width of metal bars ½ inch. I see no reason why they will not last ten years.

In boiler rooms where there is shafting, the Davis double plunger feed pump has proved to be very reliable and durable; 6 inch plungers should not be run over 25 strokes per minute. I would say avoid single plunger pumps, both power and steam, on account of the pulsations of the water in the pipes, and especially so if you have a fuel economizer or large feed water heater, as all the water contained in these must come to rest at each change of stroke, and must be made to move on again as the plunger advances, while the duplex pump keeps the water steadily advancing all the time.

The feed pipe should not be less than two inches in diameter, and is best when made of brass, and introduced into the boiler on the top at back end as shown in sketch. Where the draught is sufficient the fuel economizers —so-called, are true to name. The reduction in draught will amount to about 5-100ths of an inch of water, and at this mill heats the feed water from 140 to 220 degrees.

All valves on water pipes should be of the straight way pattern. I use a gate valve for both steam and water, and provide all steam valves over 3 inches with a ¾ inch by-pass, by which steam can be let into the pipe without shock, which is very destructive sometimes.

The following is a copy of one of the many tests that I have made. There was no special preparation made for this trial, and no allowance made for moisture in the coal The coal includes that used to get up steam from cold water and banking fires.

Duration of test....	2 days
Boiler pressure in pounds....................	101
Temperature of feed in degrees............	130
Temperature escaping gases................	392
Water evaporated in pounds........... ...	83,034
Coal consumed in pounds...	8,397
Weight of combustible in pounds...........	7,891
Coal per square foot of grate per hour.......	13.1
Water evap. per pound coal, (actual conditions)...............	9,888
Water evap. per pound combustible........	10,522
Water evap. per pound coal from and at 212.	11,173
Water evap. per pound combustible from and at 212..............................	11,889
Percentage of water in steam.......	0.5

(*To be continued.*)

◆

M. KRAFT, Chief Engineer of the Société Cockerill, at Seraing, says that he saw on the Volga three towboats furnished with compound engines, built at Rotterdam, Holland, in 1847, and the frame carries the latter date cast on it. The cylinders are opposite each other and inclined, with the connecting rods working the same crank. A long steam pipe joins the opposite cylinders, forming an intermediate reservoir. The steam pressure carried was originally 95 lbs., but the boilers have since been changed, and the working pressure at present in use is 120 lbs. The high-pressure cylinder is 30½ in. in diameter, and the low-pressure cylinder 60½ in., the stroke being 7 ft. The cylinders have piston valves. These engines are said to have developed 800 h.p. They have been at work without renewal, with only ordinary repairs, since they were first built, but the boilers originally put in have been replaced.

Foreign and Domestic Trade Literature.

THE PROCESSES OF STEAM IN ITS DEVELOPMENT OF POWER BY MEANS OF A STEAM ENGINE.*

By Chief Engineer Isherwood, U. S. N.

There has been shown that the liquefaction of steam in a cylinder doing work is of two entirely different kinds, due to distinctly different causes; one kind is the result of the heat interaction of the metal of the cylinder with the steam, whereby the varying temperature of the metal with which the steam is in contact alternately liquefies and reevaporates the steam. This is a surface liquefaction and revaporization, the action being on the boundaries of the steam as a mass, and not molecularly within the steam. The whole of the water of liquefaction of this kind is present as water in the cylinder at the point of cutting off, and the difference between the weight of steam present as such at this point, calculated from the pressure there, as shown on the indicator diagram, and the weight of feed water pumped into the boiler, gives the weight of steam liquefied by this cause.

Now, suppose the entire weight of water of liquefaction present in the cylinder at the point of cutting off to be vaporized during the expansion portion of the stroke of the piston, then, if there were no liquefaction due purely to the molecular action of the steam, the weight of steam present as such in the cylinder at the end of the stroke of the piston, calculated from the pressure there, as shown on the indicator diagram, should be the same as the weight of feed water pumped into the boiler. It cannot be more, and, if less, the difference is wholly due to the molecular liquefactions of the expanding steam hereinbefore described, from leaving the boiler to arriving at the end of the stroke of the piston. Now, if the aggregate weight of these calculated molecular liquefactions, added to the weight of the steam determined at the end of the stroke of the piston by the indicator, equals the weight of feed water pumped into the boiler during the same time, all the water of liquefaction due to the interaction of the metal of the cylinder, has been vaporized during the expansion portion of the stroke of the piston; but, if the weight thus obtained be less than the weight of water pumped into the boiler, then the difference is the weight of water of liquefaction due to the interaction of the metal of the cylinder vaporized during the exhaust stroke of the piston.

The water of liquefaction in the cylinder is vaporized under the continuously lessening pressures and temperatures of the expanding steam, partly by its contained heat, but principally by the heat of the metal, and the steam from the portion thus vaporized during the expansion part of the stroke is utilized in pushing the piston. This utilization, however, is vastly less than what would be obtained from the same quantity of heat employed to vaporize water in the boiler were the resulting steam used in the cylinder. Except for this steam from the revaporized water of liquefaction in the cylinder, the pressure of the expanding steam on the piston, as shown by the indicator, would be greatly less; in fact, a very considerable portion of the expansion pressures in the cylinder is composed of this steam of revaporization, and is not due to the expansion of the steam of the pressure in the cylinder at the closing of the cut-off valve.

The practical curve of the expanding steam, as given by the indicator, is so complicated by this steam of revaporization, the proportion of which to the steam evaporated in the boiler varies so greatly with dimensions and type of engines and with the regimen of the steam as to render the various formulæ for calculating the pressures of expansion mere rubbish. No formula—rational or empirical—can possibly be devised that will reproduce the practical pressures. The only information which can be obtained in this matter is from the indicator, and each case is a special problem requiring a distinct experimental solution.

The portion of the steam re-evaporated during the exhaust stroke of the piston, if there be any such, passes out of the cylinder not only without doing any useful work on the piston, but actually opposing its motion, thus increasing the prejudicial resistance of the condenser pressure. It also carries out of the cylinder the entire heat of its evaporation, none of which can be utilized.

A word of caution is necessary here as regards the pressure at the end of the stroke of the piston in a cylinder, when the expansion of the steam is carried considerably below the atmospheric pressure. Thus far, the assumption has tacitly been made that pure steam only is used in the engine; practically, however, there is a good deal of air mixed with it, derived not only from the atmospheric gases dissolved in the feed water, but also from the air pumped in by the feed pump, and also from the air leaked in through the various vacuum joints of the cylinder and its attachments. Now this air appears upon the indicator diagram as steam pressure, and falsifies it to that extent. Moreover, the mixture of air with the steam diminishes to a certain extent the liquefaction of the latter by metallic contact, because it causes the pressure of the steam to be less than is due to its temperature. Further, all the pressure produced by the air present with the steam falsifies not only the steam pressures on the indicator diagram, but the power developed by the cylinder, because, as that air has to be pumped out by the engine, the power consumed in this pumping will about equal the power produced upon the piston by the air. By allowing a considerable inleakage of air to a cylinder, it can be made to appear to develop a much greater power than it really does, as computed from the diagram, and in experiments using steam very expansively, this error has frequently been inadvertently made, and to no small a degree. The temperature in the condenser rarely much exceeds 100° F., which corresponds to a saturated steam pressure of about one pound per square inch; now the mean pressure in condensers is about two pounds per square inch, being composed of steam and air in equal portions. And, still more, the mixture of air with the steam in the cylinder at the end of the stroke of the piston, causing the pressure there to be higher than is due to the steam, vitiates the calculation of the weight of steam present in the cylinder as such at the end of the stroke of the piston, making it appear larger than it is, and, consequently, making the liquefactions, as computed from the diagram, appear less than they really are.

The entire liquefaction of steam due to the interaction of the metal of the cylinder, takes place in the cylinder between the commencement of the stroke of its piston and the point of cutting off the steam, or closing of the cut-off valve. From that point to the end of the stroke of the piston; that is, during the expansion portion of the stroke of the piston, the expanding steam, with continuously lessening temperatures, as well as pressures, is continuously abstracting heat from the metal of the cylinder and thereby cooling it, the temperature of the metal falling continuously from the temperature of the steam at the point of cutting off to that of the steam at the end of the expansion, or end of the stroke of the piston. After the exhaust valve opens, there is a still further expansion of the escaping steam, accompanied with further lessening of the temperature of the metal of the cylinder. Now, the whole of the steam liquefied to furnish the heat required to raise the metal of the cylinder from the temperature of the back-pressure steam to that of the entering steam, is liquefied in the cylinder between the opening of the steam admission valve and the closing of the cut-off valve. This is the liquefaction due alone to the interaction of the metal of the cylinder with the steam, but does not include the other causes of liquefaction of the steam.

If the metal of the cylinder remained constant at the temperature of the entering steam, there would be no liquefaction due to its interaction, but the liquefactions would remain the same that are due to other causes.

Up to the present moment, there is universally held in the case of a condensing engine using the steam expansively and having the boiler fed with water from the hot well, that when the exhaust steam is liquefied in the condenser the application of cold condensing or injection water, the entire heat present in the steam in the boiler will be recovered in the injection water and in the heat (ascertained by calculation) transmitted into the external work done by the expanding steam. This belief, however, is entirely erroneous; the heat ascertained as above being always greatly less than the heat present in the steam in the boiler. This fact is easily ascertainable experimentally, and is shown by every experiment that has ever been made in which the weight of the injection water, and its initial and final temperatures have been given. In fact, the difference between the quantity of heat present in the steam in the boiler, and the quantity of heat present in the injection water after its liquefaction of the exhaust steam, is exactly the quantity of heat lost as such by being transmuted into the various molecular actions of the steam while passing through the engine from the boiler to the condenser, including the heat transmuted into the external work of the expanding steam. If now, from this difference there be subtracted the heat transmuted into the external work done by the expanding steam, a quantity easily calculable, the remainder will be the heat transmuted into the other molecular actions of the steam while passing through the engine from the boiler to the condenser. Thus, not only the fact, but the amount of these molecular actions, can be shown experimentally, proving beyond the possibility of doubt the accuracy of the provisions herein shown, both qualitatively and quantitatively. The quantitative result will not be affected by the loss of heat from the external radiations of the boiler, of the steam pipe, and of the cylinder; but it will be affected, and to the amount of the heat thus radiated, by the external radiations from the exhaust pipe, from the condenser, from the air pump, and from the hot well. If these latter, however, are well protected by non-heat conducting material, and they should be during an experiment, the loss of heat from this cause will be insignificant.

The loss of heat by radiation from the external surfaces of the boiler, steam pipe and cylinder, increases the consumption of fuel in the furnace, because the resulting water of liquefaction has to be revaporized, but does not affect either the weight of steam used, as measured by weight of feed water pumped into the boiler, nor the quantity of heat present in it.

The final generalizations are as follows:

The entire liquefactions of steam in the cylinder of a working steam engine are due to the transmutation of part of the *vis viva* of the steam molecules into either internal or external work—into either mass *vis viva* or into increased molecular *vis viva* of a smaller number of molecules.

This transmutation is only possible when the steam is used expansively; consequently, when it is used without expansion, there is no liquefaction, or "cylinder condensation" properly, so-called. The heat above the heat in the feed water, found in the water of liquefaction deposited on the interior surfaces of a non-steam jacketed cylinder is exactly equal to the heat absorbed from the metal of the cylinder by the expanding steam from the point of cutting off to the delivering of the steam into the condenser. All other liquefactions from the boiler to the condenser are due to the molecular work of the steam undergoing expansion from the various causes in action, and are not affected by the metal of the cylinder.

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*A Lecture delivered before the Sibley College of the Cornell University, Ithaca, N. Y., December 13, 1889.

(To be continued.)

LUBRICATING OILS. No. 2.

The best lubricating oil is that which has the greatest adhesion to metallic surfaces, and the least cohesion in its own particles, and bearing this in mind there is no doubt but that mineral oils come first, sperm oil second, neatsfoot oil third, and lard oil fourth, hence the finest mineral oils are best for light bearings and high velocities, and to give body to mineral oils fine sperm oil is used, or when greater tenacity is required, lard and neatsfoot oils may replace sperm oil, and for the heaviest machinery mineral oils alone cannot be recommended, on account of want of body and higher degree of inflammability.

At the present time it is not so much a matter of quality which troubles the engineer, but it is the question of cost. Lubricants answering in every way what is required of them can be obtained; but their cost is far too high for the ordinary consumer, and it therefore necessitates search for compounds which will give to cheap oils the same properties as sperm, lard, etc., and be able to sell them at about half the price.

Mineral oils are the cheapest lubricants known, and yet they are often discarded for one reason, because they do not possess the same body as many of the vegetable and animal oils, and hence require a larger quantity to be used to do the same work; but, if double the quantity of mineral oil is required to do the work done by other oils, the price of the former is only one-quarter that of the latter, hence the mineral oils are still by far the most profitable to be used.

Oleate or stearate of alumina is now greatly used for giving a body to light gravity mineral oils. It is a very cheap compound, and can be added at a very small cost. The production of this "metal soap," as it is called, is well worthy of consideration, and can be well classed as a very successful issue to a lot of research work recently done by several chemists in endeavoring to produce cheap lubricants. The high-class animal and vegetable oils in such high favor amongst engineers for their lubricating powers consist principally of olein and stearin, and these two substances, which give to these oils their high lubricating powers, can now be introduced into cheap mineral oils, thereby converting them into the finest lubricants, at a cost far below that paid for castor, sperm, and such like oils. The oleic and stearic acid is obtained in the usual way from any of the oils rich in olein and stearin, and is then precipitated with alum in the presence of caustic soda, thus forming oleate and stearate of alumina. A very small percentage of this metal soap dissolved with warming in light gravity mineral oils will increase their gravity some 50 or 60 deg., will greatly improve their lubricating properties, and after filtering through fine copper gauze, will give them a brilliancy not surpassed by any of the finest animal oils in the market, and at the same time not increase their cost of production more than $2.50 per ton.

Some manufacturers use a process of thickening their oils with ordinary soft soap, but this adulteration can be easily detected by adding glacial acetic acid and warming, when the soap will at once separate.

Lardine and blown rape oil are now also largely used for giving body to lubricating oils. The former consists principally of cotton oil, which has been heated in the presence of a strong blast of air, somewhat similar to the process employed for thickening linseed oil, whilst the latter consists principally of colza oil treated in a similar manner. The presence of these "thickeners," as they are termed in the trade, cannot be said to visibly deteriorate the lubricating powers of the oil with which they are mixed; but they certainly do not improve it, and unfortunately they quickly become dull and cloudy, and in order to prevent this, rosin oil must be used in conjunction with them. A small percentage of say, 1 per cent. of rosin oil, does not deteriorate the lubricating properties of an oil; but one containing above this percentage cannot be recommended for lubricating purposes. The presence of rosin oil can be detected in mineral oils by treating a small portion of the sample with an alcoholic solution of caustic soda, heating on a water bath and evaporating nearly to dryness, then add a large quantity of distilled water and boil for some time, when a milky liquid will be formed; now add more water and warm, and notice the color of the oil that separates out, if clear, then mineral oil is only present; a brown color denoting the presence of rosin oil. As a confirmatory test, draw off the aqueous liquid from beneath and make it acid with sulphuric acid, if no precipitate, the oil was all mineral, as a precipitate, collecting on warming in brown viscous drops, confirms the presence of rosin oil. But now, if instead of a milky liquid a semi-frosty mass is obtained after having added the distilled water to the evaporated solution, a fatty oil is evidently also present with the mineral and rosin oil, add more water, when the mineral oil will float to the top if present. Now draw off the aqueous liquid and shake it up with amylic alcohol. If the alcohol separates in a brown layer, rosin oil is present. Again draw off the aqueous liquid, acidulate with hydrochloric acid and warm, when the separation of oleic acid, with its characteristic odor of fat, will show the presence of a fatty oil, either lard, neatsfoot, or cotton oil.

For the lubrication of bearings of the largest size, on which, either from the weight of the shaft or flywheel, or from the drag of belts or ropes, or from the formation of the bearing, very great pressure per square inch has to be resisted, castor oil up to the present appears to have no equal, and, in order to keep such bearings cool, it is very essential that this oil should not be adulterated. The adulterants to be looked for in castor are principally lard oil and colza, and they can be at once recognized by its density. The specific gravity of castor oil is .960; lard oil, .916; rape oil, .912; therefore if the gravity is below .955, this alone proves the presence of one of these oils. Again, another very characteristic test of castor oil is by the addition of zinc chloride. If pure it becomes yellow; if lard oil be present, it becomes milky; and if colza be present a green coloration is obtained.

Again, sperm oil is still very largely used by the leading cotton spinners, and the reason for this is that it leaves no stain and does not thicken by age or friction. Here again, on account of the high price of this oil, it is often adulterated, and generally with seal oil, cotton and mineral oils. These adulterants can also be easily detected with zinc chloride; if pure sperm oil a milky solution is obtained, and when adulterated with any of the above-mentioned oils, a brown coloration is obtained.

This article would not be complete without noticing the qualities of tallow as a lubricant, and there is no doubt but that, while in every case hydro-carbon oils are safer, and in the majority of cases are better and cheaper lubricants than tallow, even of the best quality, there are a number of cases in which engineers, although fully alive to the trouble and danger which are inseparably connected with the use of tallow, are constrained to use it, having failed to find any sufficient substitute. The great fault with tallow is that it corrodes metal, and often leaves a kind of deposit; and again, it almost always contains free acids, as much as 25 per cent. of free fatty acid having been found in a sample of town tallow. Large proportions of free acid are apt to be due to the tallow being adulterated with wool grease acids, or stearic acid from cotton-seed oil. Tallow, again, frequently contains more or less water, infusible matters, and mineral impurities, and has been often purposely adulterated with starch, China clay, whiting, etc. For the detection of these mineral impurities, a small sample of the tallow should be dissolved in petroleum spirit, filtered, the residue washed with a little ether, and dried at a moderate temperature. Boil the residue in water and add iodine, a blue coloration is obtained, proving the presence of starch; again, any effervescence of the residue on addition of hydrochloric acid, proves the presence of whiting. —*A. C. J. Charlier, in London Engineer.*

RESISTANCE OF SHIPS.

MR. W. RICHARDSON, president of the Northeast Coast Inst. Engineers and Shipbuilders, said, in a recent address to that body:

In naval architecture, as a branch distinct from ship construction, we may note the improved system of testing by weight the initial stability of vessels, and the clearer views of what constitutes the resistance of a ship propelled through the water. Thirty years ago the idea was prevalent that the resistance is due to the cleavage of the water, as if the ship were a wedge. Extreme importance was attached to the angle of the entrance and stern lines, and to their exact curve, and a narrow beam was regarded as essential to speed. But recently, owing to the investigations of the late Professor Macquorn Rankine, and to the experiments of the late William Froude, and to the clear expositions in his "Manual of Naval Architecture," by Mr. W. H. White, the Director-in-Chief of Naval Construction, and a member of our institute, it has been admitted that for slow speeds, say ordinary mercantile speeds, and in smooth water, the resistance varies approximately as the surface—provided always that the surfaces in two cases are equally smooth, for a very slight degree of fouling will increase the resistance most materially. Now, to all who have any knowledge of mathematics it will be evident that for similar forms the commonly received expression $D^{\frac{2}{3}}$, where D stands for the displacement, means nothing more nor less than the surface, and it is an expression peculiarly convenient to the ship designer, because in designing any vessel the displacement is usually the very first quantity which has to be ascertained. For this reason it would be convenient if Lloyd's rules also recognized the displacement, with due regard to the dimensions, as a basis for scantlings, and such a basis would also be fairer to the finer modeled ships. May I repeat that this law of resistance, varying directly as the surface, is only accepted for speeds so slow that no bow wave is raised, and in smooth water only? In a sea way the advantages both of absolute length and of relative length and fineness must be granted, and against a head sea the short and stumpy steamer makes but poor progress. The fact that as you increase the dimension of a vessel you increase the displacement as the cube of the dimension, and the resistance at the square only, throws a light on the satisfactory speed results attained by large steamers.

As regards resistances at high speeds there is by no means so clear a view, and the Admiralty and Messrs. Denny, of Dumbarton, both test the resistances by models in tanks, according to the method of the late William Froude. This is a costly and tedious, though perhaps an efficient method, and we can only hope that after some years of experience sufficient data will have been arrived at upon which to found the laws of resistance at high speeds. Those naval architects who have not the advantage of an experimental tank are reduced, in fact, to a guess, founded upon experience, of the value of the coefficient applied to the formula $(\text{disp.})\ (\text{coef.})\ ^{\frac{2}{3}} \times (\text{speed})^{3} = \text{ind. h.p.}$ When all is done, however, and by whatever method the resistance may be estimated, there is still the further element of uncertainty arising from the varying efficiency of the propeller.

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HYDRAULIC TESTS FOR BOILERS.

THE value of the hydraulic test as a means of detecting defects in steam boilers or other vessels subject to internal pressure, is a question with regard to which considerable difference of opinion prevails.

By some the satisfactory application of the hydraulic test to a boiler is regarded as an adequate proof of its safety equal in value to the most painstaking inspection. Others will affirm that such a test is of little or no value except as a demonstration of tightness, and that, unless accompanied with a careful and searching examination, it may be delusive; while some hold that to submit a boiler to a test of double the working pressure, as is sometimes done, is positively harmful, as the material of the structure is thereby seriously distressed, incipient flaws developed, and defects brought into existence which would otherwise have had no being.

As in most cases where divergence of opinion exists, the advocates of the various views can adduce instances which appear to support their aspect of the question; and, as often happens in technical and professional matters, the apparent difference or opinion between rival authorities disappears to a large extent when a comparison comes to be made.

That the hydraulic test is a very convenient method of testing the tightness of the work in a new boiler cannot be gainsaid, and hence its almost universal adoption, in conjunction with inspection to a greater or lesser degree, in passing of new work. As a detector of leakages it has at least no rival, and its application enables faulty caulking to be made good before the boiler has left the works, and before a leak has time to enter on its career of corrosion. The extent to which it enables the soundness and quality of the work to be ascertained is another matter, and depends on several conditions. It will be evident that if the test be applied with this object to a new boiler, the pressure should range to some point in excess of the working load if such a test is to be of any practical value. What the excess should be, so as to remain within safe limits, cannot be stated without regard being paid to the factor of safety adopted in the structure, and a discussion of the matter without reference to this point is one frequent source of confusion.

In boilers built under the inspection of the Board of Trade or Lloyd's Register, the rule is to carry the hydraulic test to double the working pressure. Under the survey of the Steam Users' Association the limit of hydraulic pressure is fixed at one and three-quarter times the working load. With some of the other boiler inspection institutions the rule is to apply only one and a half times, while one company determines the range of the test by adding a pressure of 60 lbs. to the working load for pressures ranging from 60 lbs. to about 100 lbs.; that is to say, for a working pressure of 60 lbs. the hydraulic test would be 120 lbs., or double the working load, while for a 100 lbs. boiler the test pressure would be 160 lbs., or only one and sixth-tenths the working load. Were a uniform factor of safety adopted in boiler construction by the various supervising and inspecting associations, the foregoing conflict of rules would represent considerable divergence of opinion, whereas a reduction of the results to this standard shows them to be fairly consistent with each other. For instance, in the case of the Board of Trade and Lloyd's the factor of safety is hardly ever less than 5, and is very frequently nearer 6—the precise factor depending on mode of construction and quality of workmanship. Taking it, however, for the sake of comparison, at, say, $5\frac{1}{2}$, then a test of double the working pressure would be equivalent to a strain represented by .363 of the bursting stress. In the case of the Steam Users' Association, who require a factor of safety of 5 in boilers constructed under their inspection, a hydraulic test of $1\frac{3}{4}$ times the working pressure represents a proof strain of .350 of the ultimate stress. In the case of the other inspecting institutions a factor of safety of 4 is accepted, and with this factor a hydraulic test $1\frac{1}{2}$ times the working load represents a proof strain equivalent to .375 of the bursting stress. It will be seen, therefore, that, measured by the bursting pressure of the boiler, the above practice is fairly consistent, the hydraulic test or "proof strain" being (in the three cases we have taken) respectively 35, 36, and 37 per cent. of the ultimate stress, a difference of only 2 per cent. between the highest and lowest; while it will be noticed that a hydraulic test of $1\frac{1}{2}$ times the working pressure, with a factor of safety of 4, imposes a slightly greater strain upon the structure than a test of double the working pressure where a factor of safety of $5\frac{1}{2}$ is allowed. A comparison of the results shows not so much a difference of opinion as to the range of the hydraulic test—or, as we should prefer to call it, the "proof stress"—as a difference regarding the factor of safety that should be allowed for steam boilers and similar structures. This is a point that we do not propose to discuss here at length, though we hope to return to it on some future occasion, contenting ourselves, in passing, with the remark that it is not one with regard to which it is possible to lay down a cast-iron rule.

In addition to the advantage which the hydraulic test affords as a means of proving the tightness of the riveted seams and work generally, it is also of frequent assistance in determining the sufficiency of the staying of flat surfaces, especially when of indeterminate shape, or when the stresses thrown upon them by the peculiar construction of the boiler are of uncertain magnitude. For the hydraulic test, however, to be of any real value in the special cases to which we refer, it is essential that it should be conducted by an expert, and the application of the pressure accompanied by careful gaugings, so as to enable the amount of bulging and permanent set to be ascertained. Without such readings the application of the test in such cases is worthless, and may be delusive. Indeed, the careful gauging of the boiler as a record of its behavior should be a condition of every test, and is a duty requiring for its adequate performance a skilled inspector. This is a point to which we would commend the attention of steam users, who often imagine that, by standing alongside the boiler and watching the gradual rise of the pressure guage, every information is afforded which the test can supply. How fallacious such a notion is, those who are familiar with skilled testing and gauging will readily understand, though the ignorance of steam-users on a technical point of this kind is frequently imposed upon; and our advice to such is, delegate the duty of inspecting a new boiler or witnessing the hydraulic test, to one of the regular inspecting companies, who have men in their employ specially trained for the performance of such work. The advantage accruing from such a course is well worth the fee charged for the service, and secures a searching inspection of the workmanship, which frequently brings to light defects and oversights that a mere pumping up of the boiler would never reveal. Such a proceeding alone, in fact, can only prove that the boiler is water-tight, and a boiler may be tight under test although the workmanship is of execrable character. Besides, it is well to bear in mind that the tightness of a boiler under test is no guarantee of its tightness after it has got to work. In a word, as far as new boilers are concerned, the application of hydraulic pressure unaccompanied by careful inspection and gaugings may be almost worthless, while with these additions it may be extremely valuable, especially in the case of boilers of peculiar shape, and is a precaution that should not be neglected—*Practical Engineer* (*London.*)

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BEFORE THE DOCTOR COMES.

THE Board of Education of this city are having a course of popular instruction on the subject of our caption, and the matter is so useful to our trades that we reproduce it as reported in the *World*:

"The human body is made up of 200 bones. These give shape and support to the body. They are held to the body by ligaments, just as the frame of a house is held together by clamps. This is covered by muscle, which we call flesh. All is covered by skin and fat, controlled by the nerves and nourished by the blood. The vital machinery is composed of the brain, heart, lungs, digestive and execretory organs. Accidents to the framework will occur.

"We will first take up broken bones. The symptoms and signs of broken bones are deformities of the part, motion at the point where there ought to be none, great pain generally, and great tenderness over the point of the break. If the two ends of the broken bone are firmly grasped and rubbed together, a peculiar, grating sensation is felt by the person grasping. If no doctor con be found, the first thing is to restore the proper shape to the limb. This can generally be done by grasping the fractured limb on either side of the break, and gently, but firmly, pulling in opposite directions until the proper shape is restored to the limb. This is what is known as setting the bone. If we can keep the broken parts in their proper position nature will do the rest—that is, the bone will knit. We help nature by putting on a splint or splints, which keep the bones in place like braces.

"Children's bones contain so much animal matter that they knit quickly. The bones of older people contain more earthy matter, and hence are more brittle. They knit more slowly.

"A wrench called a sprain, which is a twisting of the ligaments which hold the bones together, shows itself by a great swelling pain. The way to treat it is to bind the parts in cloths wrung out in hot water as hot as can be borne, or, as in a foot, put it into hot water. Then bind with a bandage to make the joint immovable.

"Wounds consist of cuts, bruises, punctured wounds or poisoned ones. In case of a cut wound, wash it clean; bring the parts together, and fasten a clean bandage over them.

"In bruises the parts are usually lacerated under the skin, and the blood which escapes under the skin undergoes changes which make the skin look dark-colored. All to be done for those is to cover them with a cloth wrung out in cold water. The same holds true in punctured wounds, of which a stab is an instance. The cardinal idea is first to remove all dirt by allowing clean cold water to trickle over it, and then to cover with a clean piece of cloth to keep dirt out.

"Burns vary in depth, from a blister on the surface to an actual destruction of a part of a limb. In addition to a pain, the burned person is in danger from an impression made on the nervous system known as shock. This often has to be treated, as well as the shock itself. If the clothes are on fire, throw the victim down, and wrap a blanket around. Then add water and cut the clothing away, not disturbing any parts that stick. Cover the burn with a layer of sweet oil, lard or linseed oil, vaseline—any fat not rancid. Then wrap in cloths to keep the air out. For the shock, give a teaspoonful of brandy every ten minutes.

"In hemorrhage or loss of blood from the lungs have the person lie down, with the lungs above the rest of the body, tell the person not to fear, as death from such very seldom occurs. Give ice to swallow. Blood here is bright red, while from the stomach it is dark colored or clotted, and perhaps mixed with food. Give ice and a teaspoonful of vinegar mixed with water.

"In drowning, when the person is taken from the water and shows signs of life, always begin at once, unless the weather is very cold. Take off the upper clothing and rub dry; wipe out the mouth, then turn, with the face down, arm over the head and a roll of clothing under the chest. When any water has run out lay the body on its back and endeavor to make artificial respiration. This is easiest done by seizing both arms by the elbows and swinging them around until they meet over the head, when a good, strong pull must be made upon them and kept up for a few seconds. This effects an inspiration, fills the lungs with air and enlarges the cavity of the chest by drawing the ribs up. The second thing to do is to return the arms to the sides and press the lower part of the ribs with them. A little whiskey may be given.

"For strangulation—hanging, for instance—when the obstruction is got out of the way use the same efforts to restore breathing as in drowning cases. In the event of discovering a person suffering from the effects of inhaling gas, get the person to the fresh air as quickly as possible, and use the same means described before to induce breathing.

"In case of a person choking from something sticking in the throat or windpipe, try and dislodge it with the fingers, or a blunt-pointed scissors may be used. A hair-pin with a loop on its end is also useful. Holding the person with the heels in the air and vigorous thumping on the back is also of frequent service. When children swallow marbles or coins it is a mistake to give a purgative. The strange matter will find an escapement without effort.

"When small bodies get in the eye, like cinders, dust, or chips of stone, a horsehair loop will frequently do what pulling one eyelid over the other fails to accomplish. Pure gum arabic, in weak solution, may be poured into the eye, which requires a cold bandage afterwards. In case of lime, use lemon juice and water at once.

"Convulsions in children should be treated with cold bandages to the head and heat to the body. A tub of warm water and mustard is good.

"Dislocations can usually be put in place by pulling. Dislocation of the jaw is treated by seizing the lower jaw with both hands, the thumbs on the teeth, and pushing first down and then backward.

"When a blood vessel is severed or cut in the arm or leg a tourniquet should be made of a handkerchief with a knot in it, tightly twisted so that the knot covers the artery or main blood vessel. When the blood stops flowing the pressure should cease.

"Injured persons should be removed on a stretcher or shutter, if possible, with the head above the rest of the body. Broken limbs should be laid on a pillow, with bandages to keep them from slipping.

"In the case of poisons, vomiting should be the first thing looked out for and encouraged. Don't look for clean water—the more repulsive the water the better the result. Mustard and soap and water are both good. Milk is one of the best of antidotes, and coffee is the next best."

TRIPLE SCREW PROPULSION.

Quite recently the question of propulsion by the use of triple screws has been considered by the United States naval authorities, and arrangements have been embodied in the designs for a new protected cruiser, whereby the motive power is to be transmitted through three propellers. This disposition of propellers, although somewhat novel in so large a vessel as the Americans are contemplating building, is not altogether new, as many years ago the same idea received the attention of our own naval designers, with the view of its introduction into a vessel under consideration for the British Navy. Since then triple screws have been adopted in a few cases, and with some measure of success, but there can be little doubt that before long their use will become more general.

Naval experts are already brought face to face with the fact that the disk area of the propellers of future high-speed vessels will require to be considerably augmented if engines of much greater power are to be adopted than are now to be found in the latest Atlantic liners or the most swift class of cruisers, and this increase of disk area cannot well be effected without the introduction of a third screw, especially where limitations of draught are of vital importance. The question of the disposition of triple screws is largely governed by considerations of the general design and arrangement of a vessel. The excessive width of the Imperial Russian yacht '*Livadia*' admitted of the propellers being placed at a considerable distance from one another, thereby reducing to a minimum the chances of either screw affecting the efficiency of its neighbor. This vessel was constructed on the Clyde in 1880, and her propelling machinery consisted of three sets of three-cylinder compound engines, each set driving a four-bladed propeller 16 ft. in diameter, the propellers being placed 18 ft. 3 in. apart. The speed realized on the measured mile was 15.75 knots, with a collective indicated horse-power of 12,350. Being of an abnormal type, this performance was regarded at the time as quite phenomenal, but it in every way justified the conclusions which her builder (the late Sir William Pearce, Bart.) arrived at from personally conducted experiments on a model of the '*Livadia*' tried with three screws. The disposition of propellers warranted in the '*Livadia*,' through her enormous beam, is not allowable in the ordinary type of vessel, where, within the working limits of draught, strict regard has to be paid in arranging the propellers clear of one another, so that the efficiency of the central screw may not be vitiated by the proximity of the outlying screws, as it is extremely doubtful whether any material increase in speed would accrue from the addition of a third propeller if placed close to the others—that is, if the centers of all three screws lay in the same athwartship plane, and at the same height above the keel.

Both in France and Italy the practical side of triple-screw propulsion has been looked upon with a considerable amount of favor by naval authorities. In the former country exhaustive small-scale experiments have been carried out with the view of obtaining a measure of the relative efficiencies of the single, twin, and triple systems, while in the latter country triple screws have been adopted in actual practice with torpedo gunboats. The '*Tripoli*,' which was added to the effective list of Italian warships some four years ago, is a vessel of 741 tons displacement. Her propelling machinery consists of three sets of compound engines, each set having cylinders of 19.5 in. and 35 in. diameter respectively, the stroke being 16 in. With triple screws, each of 5 ft. 9 in. diameter and 7 ft. 1.5 in. pitch, a speed of 19.8 knots has been realized on a displacement considerably in excess of her normal load—the indicated horse-power being 3,020

In the '*Montebello*' and '*Monzambano*,' subsequent vessels of the same class triple-expansion engines were adopted, and the outlying screws arranged as in a twin screw vessel, while the middle screw was placed abaft the rudder with its center just above the line of keel, and much below the horizontal longitudinal plane passing through the centers of the other two screws. Notwithstanding the advantages to be gained by the adoption of such an arrangement from an efficiency point of view, the mere fact of the propeller blades of the central screw lying below the line of keel, and causing an increase of draught, is sufficient in itself to condemn it for ordinary types of vessels.

No doubt objections to the use of triple screws may be cited, but, on the other hand, much may be said in favor of the system. In warships, where subdivision of the motive power is practically essential, it is a desideratum, and in vessels generally it admits of the employment of lighter and quicker running engines. As higher speeds with concomitant higher powers are demanded, there is every probability that triple screws will be the rule, rather than the exception, in future Atlantic liners and warships of high speed. At the same time much requires to be added to our present knowledge of triple screw propulsion before its immediate extended use is perhaps warranted, and it might prove of great advantage to the United States naval authorities if a few well-timed experiments were carried out previous to embarking on the construction of the vessel.—*Industries, England.*

◆

There are several ways of looking at the same thing, and one aspect of a certain matter is set forth by a writer in the *Age of Steel*. He says that a skillful mechanic who had worked up perfect devices for turning out an increased amount of work, and presented them to his employer, recently remarked: "I have lost all interest in advancing the work of this shop: my sole ambition is to put in ten hours per day and draw my pay. I am done with the idea of trying to advance the interests of my employer by brain labor on improved methods of doing work. The firm has several devices which save it many hundred dollars per year. I have received several kicks but no thanks in connection with these matters: therefore I am done."

How would it do to retain the devices as his own property and try to make a market for them? That would be better than looking for thanks.

◆

As to milling machine cutters, an English machinist says that for some years his firm had experienced great difficulty in getting large cutters to stand well when made of high-class steel. He had, therefore, made some of old Bessemer axles, which were brought to a low red heat, then dipped in prussiate of potash, next placed in water, and afterwards put together and dressed with emery wheels. He found these cutters were cheap and durable, that the teeth did not crack away in the hardening, as was the case with high-class steel, and that the work done by them was cheaper and quicker than with planing and finishing machines.

TRADE NOTES.

By orders of Secretary Tracy, hereafter, until July 4, 1891, the union of the national ensign and the union jack used in the naval service shall be composed of five rows of seven stars and one row of eight stars, to provide for the addition of the five new States of North and South Dakota, Montana, Washington and Idaho. Space is left in the arrangement for the addition of another star, to represent Wyoming, which will be added next Fourth of July.

⁂

Dr. Walter Jackson's jet propulsion steamer, '*Evolution*,' is nearly ready for another trial trip. The doctor prescribed change of water line, change of rudder, a large dose of extra boiler pipes, and two side ejectors. With this treatment, augmented by a new bow ejector, as originally planned, and extensive alterations to the main valve in the stern of the boat, he hopes to be able to make her do better work and to obviate the former trouble with the boilers.

[We hope so.]

⁂

William Grube was hired in August, 1889, to crawl into the boilers in the Steamship '*Alliance*' to clean them out. While he was thus engaged steam was turned on by mistake, and young Grube was so badly scalded that he was confined in a hospital for three months. In the United States District Court he was given a verdict of $750 against the Brazilian Steamship Company, which appealed to the United States Circuit Court, and recently Judge Wallace upheld the verdict and added $94 costs, with interest, to the original verdict.

⁂

In the '*Baltimore*,' '*Philadelphia*,' and '*San Francisco*' the navy possesses three fast and useful vessels, and the department has cause for congratulation on their excellent performances, all of which have been free from serious mishaps or failures. This is believed to be due, in great degree, to not having carried the reduction in the weight of their machinery to the extreme that has been attempted in some foreign vessels, which have given such trouble by their repeated failures that it has been found necessary to direct that in future a reasonable weight shall be allowed (especially in the boilers) for a required power.

⁂

The final report of the Commissioners to open books of subscription to the capital stock of the Mount Carmel Æronautic Navigation Company was filed Nov. 20 in the office of the Secretary of State. The $20,000,000 of capital stock is fully subscribed. At a meeting of the subscribers to the capital stock, in Mount Carmel, Ill., the following were elected directors for one year: Edward J. Pennington, John H. L. Pugh, James A. Pugh, Richard P. Butler, Warren C. Dewey, Lucas J. Van Allen, George W. Sinks, Frank Smith, Harry Twyford, John C. Underwood, and Obed C. Hawkes. The company proposes to construct and operate air vessels to transport passengers and freight. The principal office is at Mount Carmel. The duration of the company is to be ninety-nine years.

[Possibly for less.]

⁂

Bids are to be opened in February for a 750 ton torpedo cruiser. Great difficulty has been met with in the preparation of plans for this craft, nearly all of the available space being taken up with machinery. The idea has been conceived of duplicating the vessel on a larger scale, and preliminary calculations are now being made as to the chance of obtaining a speed of twenty-six knots out of a cruiser of 1,200 tons displacement. She will have to have at least 8,000 horse-power, and will probably cost upward of three-quarters of a million, but it is estimated that she will be a more serviceable vessel and better adapted to the purposes of her design than smaller craft. She will be armed, if constructed, with one or two of the heavier rapid-fire guns destined to destroy the usefulness of the small, unprotected torpedo boats of the '*Cushing*' class. The 750 ton vessel will be a very uncomfortable one, there being almost no accommodations for her officers and crew beyond the bare necessities, and the added tonnage will afford plenty of room in the projected ship, which will be somewhat larger than the '*Petrel*.'

⁂

The trial of the new cruiser '*Concord*,' U. S. N., ended at 1:30 o'clock Nov. 19. The vessel made as high as 17.7 knots an hour; spurting at one time, it was estimated to 18 knots, and maintaining an average for the trial of 17 knots per hour. This she did against a strong tidal current. The '*Concord*' has proved herself to be the fastest gunboat yet built for the navy. She has outstripped the '*Yorktown*,' which has until now held the best gunboat record in the service. But despite her splendid speed showing, the '*Concord*' failed to develop the requisite 3,400 h.p. This failure is due directly to trouble which arose in the second hour of the test with the after feed pump. To increase the difficulty, the starboard after boiler began to leak, and this trouble continued. Before the trial ended there were from two to three inches of water on the floor of the fireroom. On the first discovery of a leak the after blower was stopped, though the firemen continued to feed the furnaces of the defective No. 4. Then a small steam pipe burst in the early part of the third hour, filling the after engine room with steam. Notwithstanding the trouble, it is estimated that the '*Concord*' made between 3,000 and 3,200 h.p., though on this point no definite figures can be had until the indicator cards are worked up. It will be remembered that the '*Yorktown*,' a sister of the '*Concord*,' was compelled to make but 3,000 h.p. She actually made 3,413, or, roughly, 3,400. In consequence, the maximum performance of the '*Yorktown*' was make the basis for the minimum performance of the '*Concord*.' Furthermore, for every horse-power in excess of the stipulated number a bonus of $100 was offered, with an attending forfeiture of $100 for every horse-power below 3,400.

REPORT OF ENGINEER-IN-CHIEF GEORGE W. MELVILLE, U. S. A.

The annual report of the Engineer-In-Chief, of the United States Navy covers a great deal of ground. It is terse and succinct in its language, and is very plain spoken in regard to existing abuses. We have room for only that portion which deals directly with the profession. He says:

"I have to report that matters are now in still worse condition than they were a year ago, and that troubles mentioned as likely to occur are already apparent, for the number of engineer officers now in the service is not sufficient for the proper performance of the duties required of them. The number of engineer officers is now 194, of whom 4 have not had the proper engineering education and 2 at least did not wish to be appointed in the Engineer Corps. When my last report was published but one ship (the '*Yorktown*'), with modern machinery, had been commissioned; since then three others '*Baltimore*', '*Charleston*' and '*Philadelphia*' have been placed in regular service, each with one or two less engineer officers than they should have for safety and efficiency, and less than they would have if the corps was sufficiently large to permit the proper detail, but still more than will be possible when the number in the corps has been reduced to the legal limit of 170. As has been foreseen, the worry and anxiety undergone by these officers in their endeavor to keep things going and in order with the insufficient number of trained men at their disposal has proved too much for some of them, and they are breaking down. A policy which leads to such results can only be productive of disaster to the service. It requires a very simple calculation to show that the present legal numbers in the Engineer Corps will not be sufficient to properly officer the ships now in commission and those for whose construction appropriations have already been made, and this without taking into account the number required for shore duty and to provide for sickness and occasional leave, etc. Something must be done, and done promptly, or we shall not only have some serious breakdown to repair which might have been avoided, but also an accident more than likely to be attended with loss of life.

"We not only need a very much larger number of officers in the Engineer Corps, but we also need a very much better course of instruction for the young men who are each year appointed into it. It is sometimes asserted that educated engineer officers are not needed for sea duty; that practical mechanics can do the duty just as well. Such statements can only be made by the assurance of ignorance. To separate the sea and shore duties of the Engineer Corps into two distinct branches will entirely destroy the excellent system which is the result of years of experience and trial, and which this Bureau has always claimed as best for the efficiency of the navy—that is, the combination of the designer, builder, and competent user of machinery; for it is only by the actual working of the machinery at sea that many defects, either in design or construction, become apparent, and it is only when the experience gained by careful supervision and observation is afterward intelligently applied to other designs that the same or similar defects are avoided and improvements introduced.

"There is still another and very important point that is generally overlooked when considering the Engineer Corps of the Navy, and that is that they are a part of the military organization and second to none in importance. In the naval battle of the future, the engineer staff will have a difficult and important part to perform, and if there is failure in the engine room, no amount of skill and bravery on the bridge may suffice to avert disaster. Celerity of movement has decided many a naval battle and will decide many more, and the celerity of movement of a modern ship depends directly on the skill of her engineer officers.

The Engineer in Chief also calls attention to the retention of the antiquated custom of keeping junior engineer officers in the steerage. He protests that it is unmilitary in its principle, and unjustly deprives the officers of the privacy and comfort to which they are entitled.

Commodore Melville gives a complete endorsement to the Butler bill providing for the needs of the Engineer Corps, and requests the department to give it its cordial support. The necessity for improvement of the enlisted men of the corps is also set out at length. Commodore Melville insists that a course of training should be provided for them, for constant complaints are received from the new ships of the insufficient numbers and incompetency of both petty officers and men. He says:

"The principal reason for this is that the men are without any preliminary training or experience, suddenly called on to perform duty under entirely different conditions from those to which they have been accustomed, and while we have training ships and systems and schools for instruction in gunnery, seamanship, torpedoes to suit the new condition of things, we have none for men of the engineer force, and this in spite of the well-known fact that on a modern vessel 'steamanship' is of as much importance as any of them; and I have no hesitation in predicting that in future operations on sea the 'man with a shovel' will be found as important a factor as he is now recognized to be in operations on land. It has sometimes occurred to me that perhaps it might be better to take new men and accustom them to forced draught from the beginning, that having no experience they might not feel the nervousness that older hands invariably betray when first shut up in an air-tight box under air pressure, so that a little thing like the bursting of a gauge glass, or even a strange noise, may create a panic. Therefore, we should get the best young men we can and train them by actual experience. They should be young to be strong and to have nothing to unlearn, and not be possessed with the idea that they know more than their instructor. As training ships for both officers and firemen, I recommend that one of the vessels of the '*Miantonomoh*' class be used on each coast, and their regular engineer force increased by as many supernumeraries as may be thought advisable. Then the vessel should be kept under way as much as possible, and always under forced draught. The petty officers can be acquiring experience at the same time and taught their naval duties. After the petty officers and firemen have become proficient, a part of them can be transferred to cruising ships, where they will form the nucleus of an efficient force and their places on training ships taken by new men. To sum up the whole matter, we need more men in the engineer force; of these men a very larger percentage must be skilled mechanics than formerly was necessary; we must establish a proper training system for them and offer many more inducements for the better ones to remain in the service."

To show how the naval vessels are under-manned, Commodore Melville gives figures to show that on a transatlantic liner, with less requirements in the way of men than the '*Philadelphia*' or '*Baltimore*,' there are no less than a chief engineer, 18 assistant engineers for main engines, 7 assistants for the auxilliary machinery, 9 water tenders, 36 oilers, 1 storekeeper, 54 firemen, and 54 coal-heavers; total, 180 men. This force is also largely picked men.

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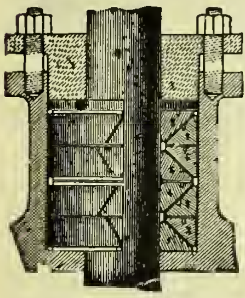

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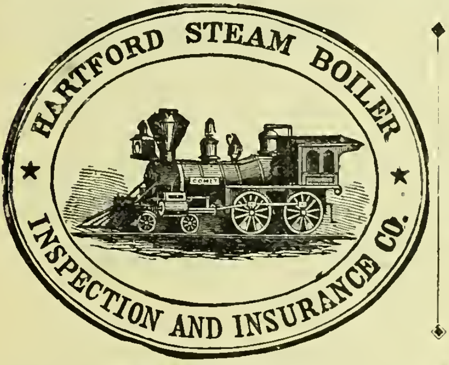

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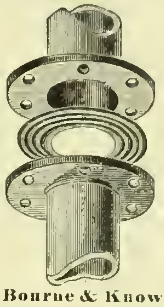

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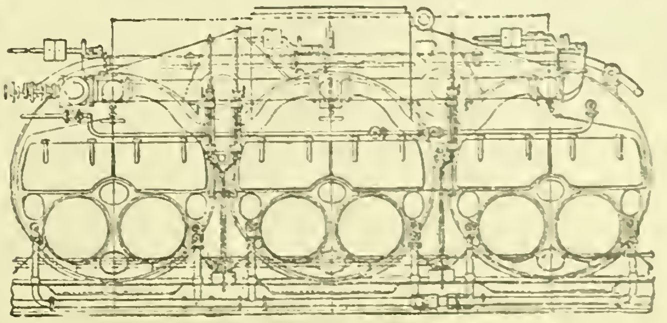

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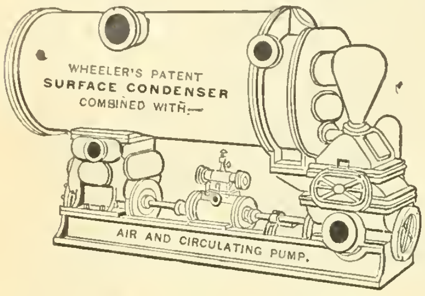

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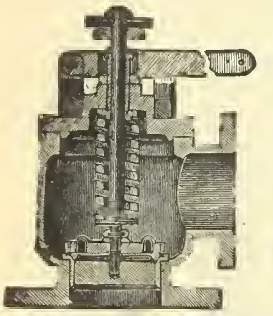

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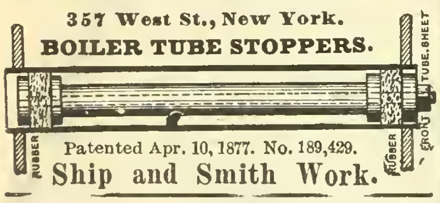

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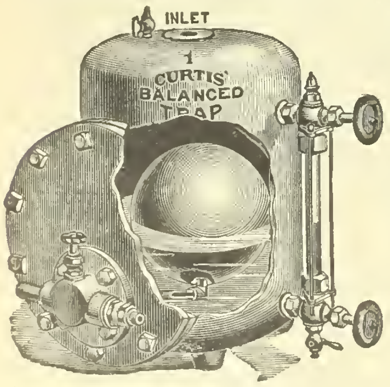

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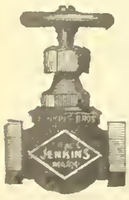

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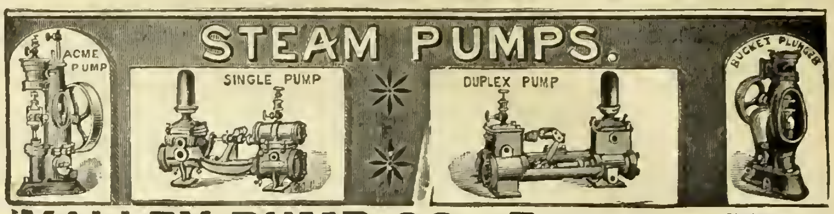

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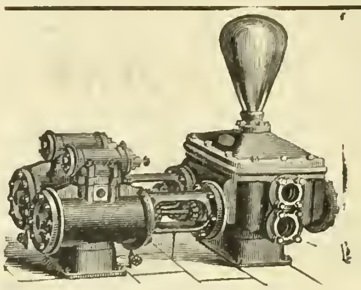

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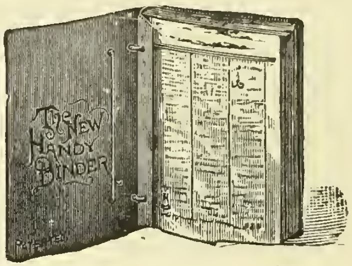

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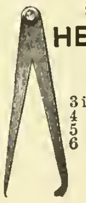

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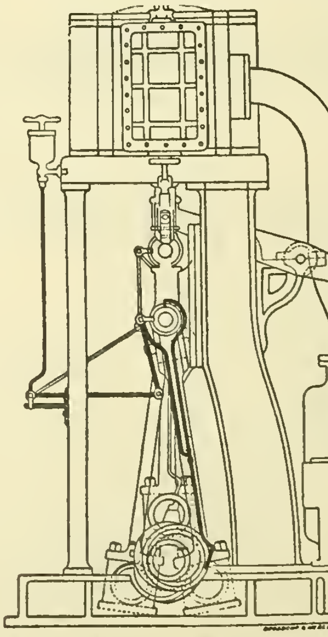

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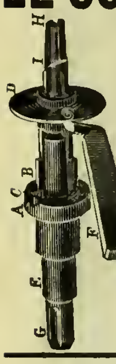

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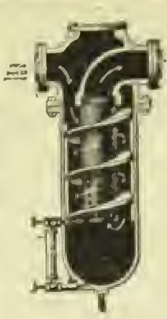

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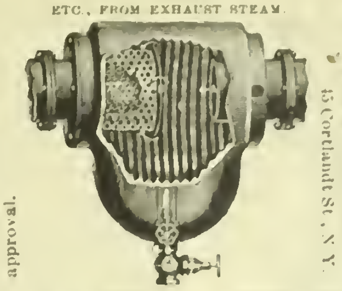

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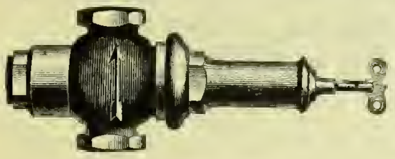

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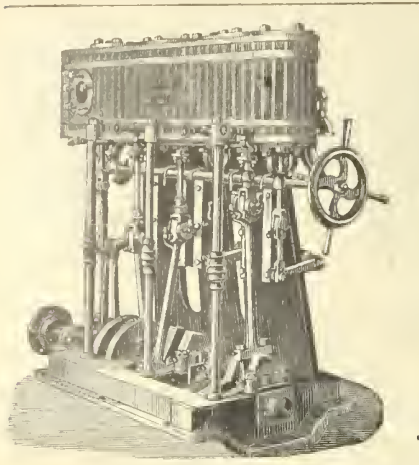

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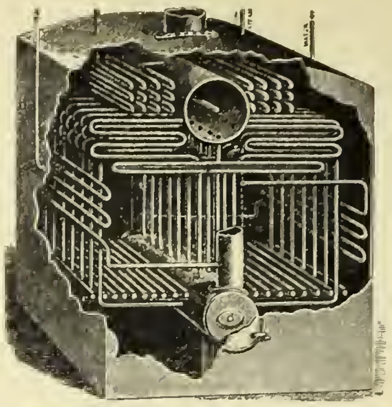

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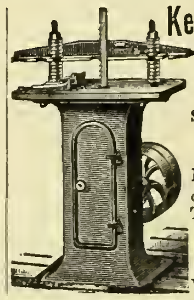

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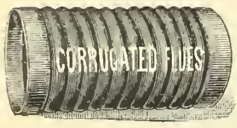

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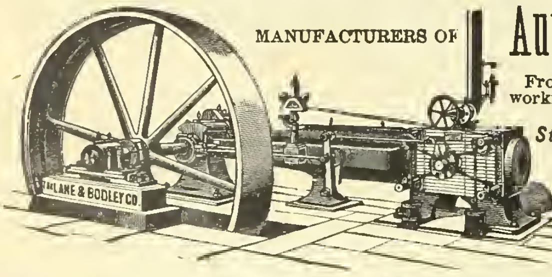

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CORRESPONDENCE SOLICITED.

THE ENGINEER.

NEW YORK

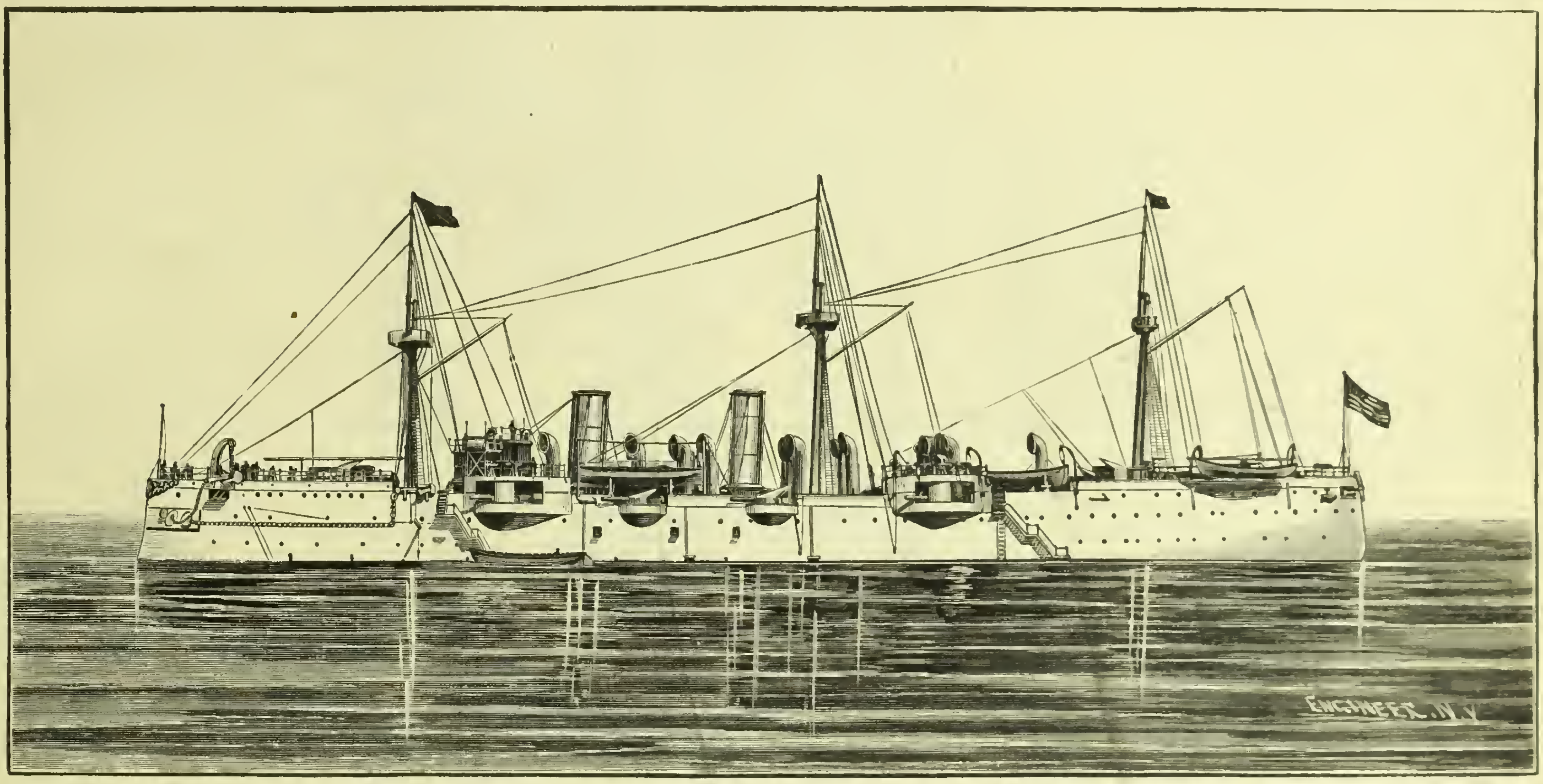
New Series, 1883, 1888. **Vol. XX. No. 13.**
Tenth Year of Publication.
STEAM ENGINEERING, APPLIED MECHANICS, AND THE ALLIED ARTS.

December 20, 1890.
$2.00 per Annum. - Single Copies, 8 Cents

THE NEW NAVY. No. 4.

The '*Philadelphia,*' U. S. N , Cruiser.

Our engraving represents the '*Philadelphia,*' U. S. N., cruiser, twin screw, which is in general appearance very similar to the '*Baltimore*' and class. She is a very fast ship and was built by William Cramp & Sons, in 1889-'90, under the superintendence of Horace See, of this city. The engines are triple-cylinder, expansion, with cylinders $\frac{38''\cdot 58''\ 86''}{40''}$. These are driven by four Scotch boilers, each 19′ 10″×14′ diameter, having four corrugated furnaces each; total grate surface is 624 square feet; total heating surface is 17,601 square feet. The working pressure is 160 lbs. per square inch. The '*Philadelphia*' is one of the fastest naval vessels afloat, having made on her official trial 19.67 knots per hour as a mean of four hours run under forced draught. She is 335′ long, 48′ 6″ beam by 31′ deep with a mean draught of 19′ 2″, with a displacement of 4,325 tons at the above draught; her normal coal supply is 400 tons, but she has capacity for 850 tons. The '*Philadelphia*' is an American ship throughout and reflects the greatest credit upon her designer and builders.


ENGINEER. N.Y.

◆

A pneumatic dynamite gun is being constructed in England to use compressed air at 5,000 pounds per square inch; it is 15″ diameter, and is intended to throw 600 pounds of dynamite three miles. The air compressor is of special design, and has four pistons which decrease in diameter as the pressure increases. The first piston is 12″, the fourth is 2½″ diameter.

◆

President John H. Galwey has made arrangements for the delegates to the National Convention of the M. E. B. A., to be held in Willard's Hotel, Washington, D. C., January 12.

The Belleville water tube boiler is meeting with great success in its application to land and marine service. The total horse-power in use is very large, the marine service alone having 14,000 horse-power in one ship, while others of 8,000 are common. Foreign naval powers, the Danish, French, Spanish, Russian, Italian, Japanese, Grecian, Portugese, etc., have adopted it and have many vessels fitted with it for years. These boilers have been supplied to the vessels of the French Navy under a law which declares that none can be accepted incapable of steaming for six consecutive weeks under full furnace power, using sea water alimentation only, and sustain no injury. This provision enables a vessel to reach home from the most distant point, with disabled condensing apparatus or loss of fresh water for feeding. Several trial tests have demonstrated that Belleville boilers fulfill this requirement without damage, and are superior to the Scotch type under the same conditions. Miers Coryell, 21 East 21st Street, New York, will supply other facts upon request.

◆

The docility of Japanese is frequently commented on, but to handle large bodies of Japanese—in factories, or in engineering works—is not so simple, even when the foreigner is superintending work done for the Japanese government itself. The verdict is that their sense of responsibilty and morality is so very small that absolute firmness and strictness are requisite. The Japanese never believe that discipline is in earnest till it becomes a scourge.

◆

A zealous young friend of The Engineer in Ohio writes:

> "I asked some engineers around here to subscribe for your paper and they said they wouldn't."

It is evident that he asked the wrong men; he ought to have asked those who said they would.

A financier says, in the daily press:

"I often say to friends who do me the honor to consult me about proposed investments: 'Do all your running around and questioning before you pay out money, and then if you decide to make the investment, keep quiet and give no heed to the idle talk of people who know nothing.' "

This is good advice; better advice is to heed the talk of people who know something, engineers for instance. Capitalists look at the financial side only. They will get big returns '*if,*' etc. Engineers know why they will not get returns, but investors turn a deaf ear.

◆

Nitrous oxide gas, which dentists use for producing insensibility to pain, contains nothing but the elements of the common air. The only difference is that they are mixed in another proportion. The air contains four parts nitrogen and one part oxygen; nitrous oxide is half oxygen and half nitrogen. The operation of the latter upon the human system is very different from that of ether or chloroform. The gas stimulates the circulation and nerves until the latter lose sensibility. Ether and chloroform depress the vitality.

◆

Professor Roberts has stated that the great smoke cloud which hangs daily over London weighed 300 tons, 50 tons of which was solid carbon and 250 tons of hydrocarbon. It was calculated that the smoke of the year was worth £2,000,000.—*Mech. World.*

[We would sell it for ten per cent. of the sum named.]

◆

Friends who may have clubs are respectfully requested to forward the names at the earliest moment; by so doing they will insure prompt receipt of the first issue for 1891.

WOOD PLANING MACHINE CUTTERS.

We have noticed recently in exchanges, remarks and instructions respecting the above-named method of sharpening wood-cutting knives, and do not deny the right of any one to file cutters when they choose, but must at the same time adhere to an old opinion that any cutter for wood work, except a scraper, that is tempered below a straw color, is of little use in working wood of any kind. There is always a tendency to set cutters too flat, that is, at such an angle that when the cutters are hard the edges will grain out in gritty stuff; this we contend is a mistake. If those who file cutters had some experience in working banyan, boxwood, rosewood, and so on, they would learn some things of advantage. They would learn that caps to prevent splintering are of no use, also that edges at ordinary angles are destroyed at once on these hard woods. They might also learn that these woods or any other of the harder kinds can be worked true, smooth, and regardless of grain, by making the cutters hard, their edges obtuse, and setting the face nearly radial from the center of the spindles.

At the Ohio Tool Company's Works, in Columbus, Ohio, where there are twenty or more machines for planing wood, nearly all the cutters are set with their faces "radial." The profile or faces of moulding planes of all kinds are worked to a finish over the hard beech, boxwood, rosewood, or anything except metal, and the work is highly finished as it comes from the machines. The saving thus effected is not only in time and quality, but also in cutters, which do not cost more than a third as much, because they are not made on a bevel, but are cut out precisely to the pattern wanted, and are keyed into the heads radially from the center. They are "keyed in" we say, because screws are not safe at the high speed necessary. Some of the spindles used in "boxing planes" are driven at 12,000 revolutions per minute, but these have solid or milling cutters.

Many years ago some of the makers or users of wood-working machines around New York discovered that their matching cutters for planing machines worked better when "wrong side out," and from this followed grinding the "inside" as is now common for matching and shaping machine cutters.

Now all this is merely altering the angle. The grinding face takes the place of standing face, or in other words, the cutters are set at a new angle, nearly radial. We think some millions of dollars in waste time, expense and bad work, is chargeable to setting wood cutters at acute cutting angles, especially for dry and hard woods. Those who doubt this can try the experiment of hardening their cutters to a pale straw color, and then grinding a bevel on the face side to an angle obtuse enough to stand the work.—*The Journal Industry, San Francisco.*

◆

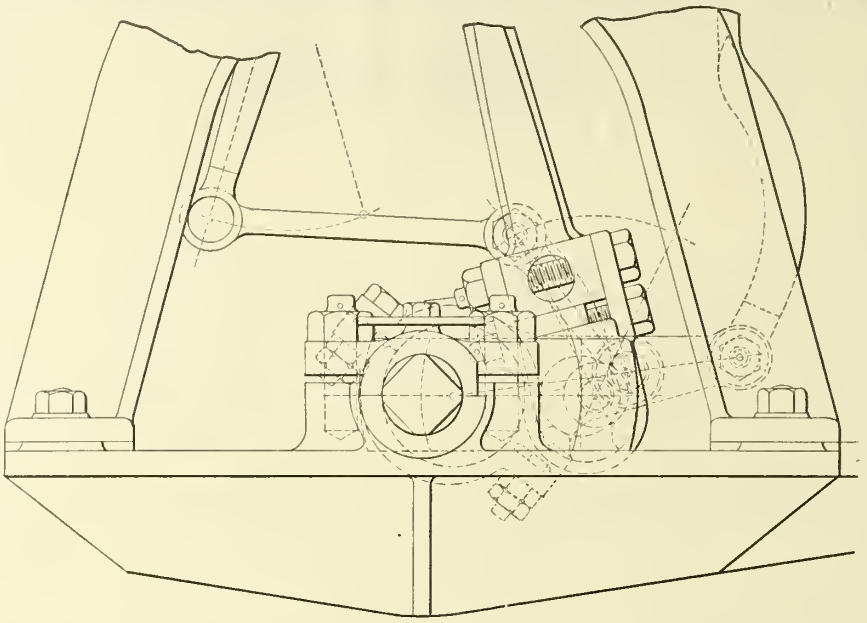
This is a treatise on boiler explosions by R. James Abernathey in the *American Miller:*

"Every man and boy operating a steam boiler should be taught that while other causes may exist, the steam itself is all sufficient to produce the most appalling results, and that it is just as dangerous to trifle with a steam boiler as with a powder mill. If all were so taught, there would be fewer boiler explosions. In the first place, steam boilers ought to be made very strong, and of the very best material. In the second place, none but the most careful and competent men should be put in charge of them. The owners of such boilers could then feel safe in allowing the search for the mysterious to go on.

R. James, if you had written a "tome" of 40 pages on this subject you could not have said any thing more pertinent.

RADIAL VALVE GEAR.

In the issue of November 22, "*Small Compound Engines,*" page 123, the radial valve gear upon the engine was so small as to be indistinguishable. We have therefore enlarged it as in the engraving herewith, so as to be plain to all. It is, of course, understood that there is only one eccentric for both motions—ahead and back, and that the valve stem is connected directly to the end of the eccentric rod; this has a rocking motion up and down on an axis shown in dotted lines, and not a horizontal reciprocating motion, as usual.



◆

ANOTHER NEW INDICATOR.

Indicators for steam engines seem to be multiplying in numbers nowadays, and we illustrate herewith one of the most recent for which improvements are claimed. It is taken from *Industries*, England, and is the invention of E. Hall-Brown, England.

Fig. 1 shows an elevation; fig. 2 is a plan of same; *A* is the cylinder enclosing the piston, *B* the piston, B^1 the spring, *C* is the drum, *D* is a bracket or other support for the drum *C*. The parallel motion is formed by the following parts: *E* and *F* are connecting the piston-rod head B^2 to the levers *G* and *H*. The lever *G* is jointed to the plate *J* at G^1. By having these levers and links suitably proportioned, the marker *1* may be caused to move in an approximately straight line and at a practically constant ratio to the motion of the piston rod head B^2. The motion plate *J*, which carries the joint G^1, and by means of which the parallel motion is capable of limited rotary motion about the cylinder *A*, is mounted on the cylinder cap *K*, and secured by means of the plate, which is held in place by screws. The cylinder cap *K* is secured to the cylinder by pins *L*, *M*, and the catch *N*. This circular catch is held in place by the motion plate *J*.

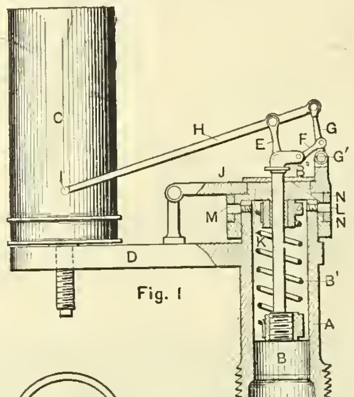


Fig. 1

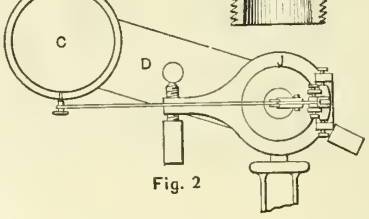


Fig. 2

That the Niagara Falls are receding at the rate of more than two feet each year is the most significant fact brought out at a meeting of the Commissioners of the State Reservation at Niagara. State Engineer Bogart's report showed that since the year 1842 the total mean recession of the Horseshoe Fall had been 104 feet 6 inches, an average of 2 feet 2 inches a year and a fraction over. Mr. Bogart also made a statement as to the effect which the diversion of water from the Niagara River through the tunnel lately projected would have upon the volume passing over the American Fall. The point of diversion is 1 36-100 miles above the Falls. It is estimated that about 270,000 cubic feet of water pass over the fall every second. As the capacity of the tunnel is 10,000 feet in every three feet of fall, there will be a reduction of 1 3-10 inches, if the tunnel runs full, or less than half an inch for every foot.

◆

Respecting forced draught trials of new boilers, a correspondent of a foreign paper makes this point: It has always seemed to me unfair to a marine boiler that has, perhaps, not been steamed half-a dozen times, to be taken on a trial and worked within an inch of its life. Everything is against its doing well, for one reason: however careful men may be, there is always sure to be a quantity of grease on the plates of a new boiler, and which takes some short time to be got rid of. Besides this grease causing a tendency to prime, we all know what an injurious effect it has when there is a coating of it between the water and the furnace, or any other plates exposed to the action of the fire. I cannot but think if the engines and boilers of new ships were allowed to work for a short period before being put to such severe trials, the results would be more satisfactory.

◆

A cement of universal adaptation, that is readily and permanently adhesive to any substance, has long been a desideratum. Professor Winchell's method is to take two ounces of clear gum arabic, one and one-half ounces of fine starch, and one-half ounce of white sugar; the gum being pulverized and dissolved, both starch and sugar are dissolved in the gum solution, the mixture being suspended in a vessel in boiling water until the starch becomes clear. The cement should be as thick as tar, and remain so, prevention from spoiling being insured by gum camphor or a little oil of cloves. This cement is so strong that it will hold glazed surfaces, repair broken minerals and fossils, and has innumerable adaptations in the arts.

◆

"It is much easier to build an iron ship than a wooden one. It requires far less judgment and less mechanical skill. This every iron shipbuilder will admit, as nearly all have at some time been engaged in building wooden hulls. In building a hull of iron, the raw material is fashioned into any form required. Wood shaping, on the other hand, demands much judgment and skillful treatment. This particular branch of the work was usually in charge of the most skillful mechanic in the yard, who was known as the converter. In my opinion we have lost nothing of the art of shipbuilding, and although the best ships ever built, the American packets, have passed out of existence, the freight ships now built in the East are the equal of any we ever had."—*W. H. Webb.*

◆

The House has passed the Senate Bill providing that in open steam launches of ten tons or under one person may act in the double capacity of pilot and engineer.

ICE FACTORIES.

THE failure of natural ice last winter gave great impetus to the manufacture of artificial ice—factory ice, as we may call it—to distinguish it from natural. We have heard reports of the success of these from various sources, but nothing definite from special points until recently, when the announcement is made that the Kruger Ice Company, of Newark, N. J., which has been in operation only six months, have declared a dividend of ten per cent., that is to say, twenty per cent. per annum. It is possible that many will think that this is a small earning, but most persons would be very glad to have their capital invested safely at half that interest.

The Kruger Ice Company is run in connection with a brewery, we believe, and is now manufacturing forty tons a day for outside use. During the summer it made 120 tons a day, and it will now begin to store ice in its ice house. It is delivering ice now at twenty cents per hundred, but last summer the price was eighty cents, where ice companies demanded $1. The company is contemplating additional facilities for next season.

There are certainly no mechanical difficulties in the way of making ice cheaply; the financial success of such companies depends upon the sagacity of their managers.

◆

MR. WATSON, of THE ENGINEER, thinks that 6½ hours a day for nine months, and 5½ hours for three months, with 30 days of play, is not evidence of a "want of force" in the bureau service at Washington; but it is, all the same. Things do not work that way. Shorten the hours of these horny-handed workers and they consistently shorten their performance in proportion. The increment of effect is in grumbling, not product. No one seems to understand how hard he or she is working until half the load is thrown off; then the strain on the machinery begins to appear. Out here, where even the scavengers, clam-diggers and tramps have unions and short hours, we can observe this matter better, and like Professor Tyndal, see "hope and promise" of a complete cessation from toil by shortening the hours of labor until they disappear entirely.—*The Journal Industry, San Francisco.*

[Thanks, Mr. Richards, of the above periodical, but we do not remember to have uttered the remarks quoted; and cannot find them in our paper.]

◆

"CHARLES D. THURBER, of this city, chief engineer of the Pepperell Manufacturing Co., has lately received a prize of $25 from THE ENGINEER, a steam journal published in New York, for the best article on the Corliss engine, several of which are used on the corporation. Mr. Thurber is one of the best engineers in this section, and the fact that he was chosen to receive the prize from a large number of competitors, is quite an honor to him."—*Biddeford Journal.*

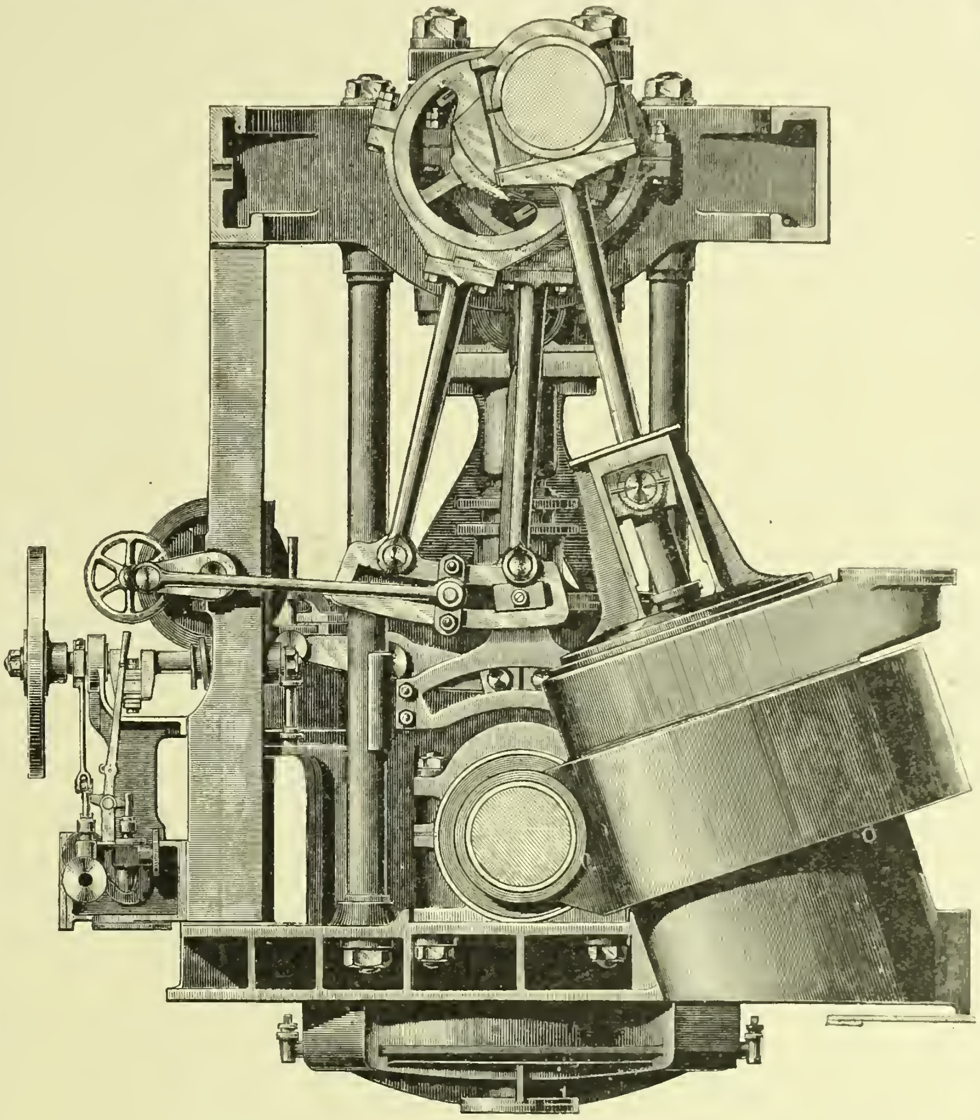
◆

IT seems to be admitted that the total failure of natural gas is a question of a very short time only. This puts manufacturers who have accepted bonusses from small towns to settle in them, by reason of the cheapness of natural gas, in a bad fix.

OSCILLATING ENGINES.

A TYPE of engine which has many advantages, and the reverse, is here shown as applied to a paddle steamer, recently built in England. These engines are twin cylinders, simple expansion, working on an ordinary crank shaft; from this latter is worked the air pump also, as shown in the foreground of the engraving. The cylinders are both 37″ diam. by 36″ stroke, and have plain slide valves worked by links. The motion of the cylinder will not admit of the direct attachment of the usual valve gear, and this difficulty is overcome by making the end of the rocker arm work in a slotted yoke, to which last the link motion is attached.

A surface condenser fitted with a centrifugal pump condenses the exhaust steam, and the air pump is fitted with brass valves for the purpose of enabling the feed to be used at an economical temperature.



The dimensions of the steamers are: Length between perpendiculars, 165 feet; molded breadth, 21 feet; depth, 10 feet; load draught, 5 feet; and with an average of 580 indicated horse-power on the trial, they attained a speed of 13.6 knots, the highest speed on any run being as high as 16 knots.

Some passenger and freight steamers on the Sound are fitted with engines of this type, but they are exceptional in this country. The engraving is taken from the *London Engineer.*

◆

HERE is the saying of a man with good intent:

> "Now, it is absurd for any man with a perfect understanding of these two forces to argue that both of these forces cannot be combined in the same, etc., etc."

Yes, dear sir, but what do you mean by "a perfect understanding?" Is there any such state of mind? You understand a given subject as far as you have got in it, but some other man has gone further than you have—so all your deductions are weak because your premises are false. You have not a perfect understanding of the matter. A perfect understanding cannot be attained by a mere man.

AUTOMATIC EXPANSION vs. THROTTLING ENGINES.

IN a paper on this subject read before an English Engineers' Association, Mr. J. Harper said:

Although most engineers agree as to the superior economy of the automatic expansion (over that of the throttling) engine, yet I do not think it strikes the majority of the great saving in the fuel there is, compared to engines fitted with gear wherein the point of cut-off is fixed relative to the stroke of piston. In the best possible type of throttling engine, on account of the bends and passages the steam has to pass through, the initial pressure in the cylinder never attains boiler pressure; the effect of this is that when a considerable load is thrown off its speed is increased, when additional load is put on its speed is diminished. Now every stroke an engine makes above its normal speed is a waste of steam, and if the engine be large a vast waste takes place; on the other hand a loss of speed reduces the production of a whole factory in direct proportion to reduction, the loss of one revolution in twenty reducing the capacity of every machine 5 per cent. A variation of one revolution in five in a throttling engine is common, and in most cases is unavoidable.

There are some engineers who still think that this class of engine can compete with the automatic engine, but it is a remarkable fact that they take every precaution to avoid throttling in the passages. Happily, these relics of a bygone age are becoming fewer in number. If the practice of estimating the efficiency of a steam engine by its consumption of steam were more common than it is, we should hear very little of "throttling." The present practice of estimating the efficiency by the coal consumption (involving as it does the combined efficiency of the engine and the boiler) is not fair to one or the other. This has been pointed out again and again.

◆

HERE is a sermon in a few words: "For myself," says Mr. Stanley, "I claim not exceptional fineness of nature, but, beginning life as a rough, ill-educated, impatient man, I have found my schooling in these very African experiences, which are said to be detrimental to European character. I have learned that self-control is more indispensable than gunpowder in order to rule and keep one's life among Africans. It is needful resolutely to regard and treat them as children. It is only by showing ourselves superior to savages that we can attain that control that is necessary to their welfare even more than to ours."

And to others besides savages, let us say.

◆

SEND to Roberts' Safety Water Tube Boiler Co., 18 Courtlandt St., N. Y., for their water tube boiler circular and testimonials. There is some very good reading in them, and useful data as to sizes of boilers for boats and engines.

◆

FRIENDS who may have clubs are respectfully requested to forward the names at the earliest moment; by so doing they will insure prompt receipt of the first issue for 1891.

Letters to the Editor.

To avoid misconception we state that this department is open to all. The experienced and inexperienced mechanic and engineer meet on common ground, and are free to express their views in their own way. No communications will be suppressed except their tenor and tone are against the policy of this page. Personal reflections should be carefully avoided. Correspondents need not hesitate to write for supposed want of ability. Such corrections as are needed will be made with pleasure. It is specially requested that all figures be made very plain and all proper names clearly written.

A LETTER FROM MR. MAN.

Editors ENGINEER:

I see you addressed a sort of "open letter" to me in THE ENGINEER of December 6. Well, now I want to tell you that you were mistaken. I knew all the time that I had a narrow escape from being out of a job this winter, but for the life of me I can't see any logical reason why I should be out of a job because the Baring Bros. manipulate certain pieces of paper in certain ways and have the wrong pieces of paper come out of the bag first, or something of the sort. Other financiers came to their rescue, did they? And they let the Baring Bros. have some pieces of paper, until the pieces in Baring Bros.' bag got to the top again, didn't they? Now what has all this got to do with my job this winter? Supposing that the other financiers hadn't come to their rescue? There would be just as many bushels of wheat, and pounds of beef, and wool, and cotton, and iron in the world, and just as many men would want to read THE ENGINEER as now. Just as many people would want clothes, and books, and machinery. Now, if I am making machinery and you are making THE ENGINEER, why in the name of common sense, if I want THE ENGINEER and you either want some of my machinery, or something made by my machinery, shouldn't you keep on making THE ENGINEER and I keep on making machinery? Oh, we can't get the money. Can't we? Why not? Because the Baring Bros. had sent all they had to South America, and the miserable South Americans hadn't returned it promptly, or something of the sort, and the other "financiers" got scared, and locked up what was left, and wouldn't let us have it at any price. So, no matter how much I want THE ENGINEER, or how much you want one of my lathes, we can't have 'em, because some of these other fellows have got some pieces of paper, and perhaps a few pounds of gold and silver, locked up in the Bank of England, or in Wall Street somewhere! Funny, isn't it? Now, when money isn't tight, and some large manufacturer, for instance, wants a few hundred or a few thousand dollars to make up his pay-roll, what does he do? Goes to the bank and borrows, doesn't he? On the strength of what? Well, on the strength of his buildings and machinery, and merchandise on hand, or partly done, etc., but if the "financiers" have the money locked up and won't let him have any, then he can't pay me, and I am out of a job, although thousands of people want the goods he has on hand, or partly done, and are willing to work for them; but they can't work, and I can't work because some pieces of paper are locked up somewhere. There is just as much wealth in the world as ever, but the pieces of paper are locked up, and I am out of a job and without the necessaries of life. Strange, isn't it? Seems as if there was a nigger in the wood pile somewhere.

Now, Mr. Editor, there *is* a nigger in the wood pile, and if you want to know where I think he is, I shall be glad to let you know in another letter, and will close this one by saying that "the greatest financial panic of the century" is only put off for a little while. Take notice, I say a *little* while. The conditions are ripe, and it's "got to come," but if enough people would do some hard thinking between now and then, the panic would be the salvation of the world. The industries of the world would cease to be under the thumbs of "financiers" and a condition of things set in which would be little less than the millenium. "Let us all be thankful for what did not happen" indeed! Let us all kick ourselves for being such monumental asses as to allow a condition of things to exist that makes financial panics possible!

Go to! You make me think of the woman who was thankful that her husband was drowned because her son needed a new suit of clothes, and his father's clothes just fitted him. Yours, with eyes open,

MR. MAN.

Connecticut.

[Mr. Man is a manufacturer in a certain line, and he writes spiritedly and is full of his subject, but—may we say it—without full knowledge. He has dived into very deep water. Political economy is an abstruse subject, and to be carefully handled by those who have not studied it in all aspects. We have not, and therefore cannot, enlighten Mr. Man as to his errors (assumed upon our part) of judgment. Gold—money, in other words—is the standard of all values the world over, and if those who hold it or control it, lock it up and do not put it into circulation, it matters not how much iron, wheat, coal, or any other product there may be in existence. If it cannot be exchanged for the universal circulating medium the products have no value, or but a limited value. We do not want a ton of coal for subscription to THE ENGINEER. We want $2 in a recognized medium, which we can hand to some one else in payment for his work for us, and this is commercial custom the world over. All business is transacted upon credit, in the full belief that Mr. Man or Mrs. Woman will pay when they agree to in the currency recognized. If for any cause they fail to do so in large numbers, anxiety and distress of mind ensue, and a financial panic is born at once. It is easy to say that there is no occasion for them, and that they might be averted by mutual forbearance; so they might, but all men are not alike, and where one can put up with reverses, another loses his head and heart, and causes other to do the same.

If Mr. Man is not grateful that financiers did not permit a universal panic to occur, we are, for we are not fond of them, or "ructions" of any sort in trade circles.]

THE BELLEVILLE WATER TUBE BOILER FOR STEAM YACHTS.

Editors ENGINEER:

I have just put the steam yacht '*Shearwater*,' owned by J. M. Forbes, Boston, Mass., into winter quarters, and find her Belleville boiler in fine condition. This makes four years that the boiler has run without repairs. I see no signs of pitting or corrosion. I have given this boiler severe trials the past year, using salt water around Cuba and Florida on last winter's cruise; last summer the condenser gave out and I was obliged to use all salt water for a number of days. There was no foaming while running, and I could not find any scale in the tubes. A severe test was banking fires and lying for hours with the salinometer at 4½. That is the time when there is the most danger of scaling an ordinary water-tube boiler, because there is no good circulation, but this boiler has good circulation while any fire is kept under it. Sometimes we laid several days with banked fires, keeping a little steam, so as to be ready to sail on short notice. If we want a little steam for any purpose it is not necessary to spread the fires, but just open the draught and steam will make immediately. The automatic feed on this boiler has never failed or been the cause of any anxiety, and engineers well know how to appreciate that fact. Some naval engineers were out with us last summer, and they were loud in their praise of its working.

The Belleville water-tube boiler is being appreciated by owners and engineers, as the owner of the '*Shearwater*' built a 54 foot steam yacht two years ago, and ordered one of these boilers. It has worked well, without repairs. The Atlantic Works, Boston, are now building a large steel cruising yacht for Mr. Forbes, which will have two Belleville boilers. The owner of a New York yacht in New York is removing two water-tube boilers that proved a failure, and has ordered two of the Belleville type. Another well known New York yacht owner is to remove two more water-tube *failures*, and is talking very favorably of this kind. A concern building a new steamship has ordered four of the Belleville boilers, and as the merits of the boiler are better known they will be more and more used than the present Scotch boiler. pressure of steam now used. They have to be built so heavy to stand these pressures, and the cost of repairs are very large, and it causes boats to be laid off for days undergoing repairs, and it takes all the time in port to clean them. In the Belleville boiler the engineer could easily make any repairs if they should be needed, and boilermakers would never have to be called in. Cleaning them only consists of removing the sediment from the chamber, made for this object. I hope I haven't encroached too much on your space, but so many have asked me about this Belleville boiler from time to time, that I take this method of telling them, as THE ENGINEER reaches nearly all such persons. Moreover, it is the only paper that I know of where an engineer is sure to get a hearing on writing any article. We all know how to appreciate such treatment.

ENGINEER OF THE '*Shearwater*.'

Boston, Mass.

THICKNESS OF CYLINDER WALLS.

Editors ENGINEER:

I would like to ask the correct method of finding thickness of cylinders with full margin of safety, and also whether this comes under the inspectors of engines. I have looked in *Haswell's Lectures*, *Reed's*, *Main & Brown*, *Templeton and Adams' Notes*, which last, on page 82, gives more explicit data than the others, though not satisfactory. Your library is larger than mine, and your head is bigger, so please give your solution of it. A cylinder 22¾ dia. now (when new 22 in.), is only ½ in. full, thick; at 80 lbs. pressure is it not under safety limit?

SAM'L BOSTOCK.

Coosaw, S. C.

[There is no hard and fast rule for thickness of cylinder walls, and there cannot well be, for the mere tensile strength of the metal exposed to strain has little to do with the matter. Stiffness to resist change of form has much more to do with it. The total sectional area of metal to resist strain in a cylinder whose external diameter is 22.75, and half of one-inch thick, is 37″.30, which, with cast-iron, has a value of 15,000 lbs. per square inch, factor of safety included. The area of a piston 21″.75, is 371.½ sq. inches, which, multiplied by the steam pressure, 80 lbs., gives only 29,720 lbs. total strain at greatest load. It is easy to see, therefore, that in so far as mere strength goes, the cylinder with walls ½ an inch thick is amply strong. But for insurance against accidents from water getting in, it is too light, and for permanence of form it is too light, for the expansion and contraction are influenced by the steam chest on one side.

Inspectors of engineers have nothing to do with this question legitimately, though many may endeavor to bulldoze timid men into answering it and similar questions. The law is explicit, and limits an engineer's acquirements to braces and safety valves, and in the latter to a type which is now obsolete. The lever safety valve in sea practice is done with, the pop-valve having taken its place. Observe that the law requires men to know how to figure a lever safety valve, and demands that owners shall use the pop-valve! Fine, is it not?]

FINE READING, THIS.

Editors ENGINEER:

I would like to ask if anyone can get an engineer's special license, use it for a few days, then at the end of the year get a permanent license, and continue renewals? The same party has a captain's license, renews both, and keeps the two in the pilot house.

Now this youngster was born a captain. Though he did go on deck a short time he was too high for the work, and was never properly appreciated (in his opinion). Now (as captain), there are no engineers around here; he is the same smart Aleck, and will give his opinion of men who have been longer in the trade than he is years old, as if he were a Watt Newton, or one of the greatest experts in the country. This man got this special license so as to cover the position of engineer on a pile driver with motor power (side wheels) during one of the long intervals he had in pressing brick, having been relieved from command of a very fine boat on account of his abundance of knowledge and ability.

All this is only to show how easy it is to get an engineer's license.

He also advances it each year.

What is your opinion of it?

AN OLD ENGINEER.

[Our opinion is that it is a fraud on all concerned, pilots, captains, owners, and engineers in the locality where such things are suffered to exist. The attention of General James A. Dumont, Supervising Inspector-General, is called to this, and to similar cases. His attention is also called to the fact that they will always exist until the law which requires individuals to make complaint in such cases is changed. The Government should make the complaint and the investigation, upon full information. Uncle Sam should seize such persons as are mentioned above by the scruff of the neck and run them down a steep place into the sea.]

SPECIAL NOTICE.

THIS number closes the year 1890, and with it our contract with some thousands of friends in all parts of the country. Many of these have anticipated the annual "round up," so to call it, and renewed their favors for 1891, but there are some who have not had time to attend to it. As our older readers are aware, we do not send papers after the subscription has expired. We do not force THE ENGINEER upon anyone, but leave all persons to judge whether they want it or not. To this end we remove from our list all names unpaid for the ensuing year, and we begin to do this now, because newspaper work is always two weeks in advance of the actual date. If any of our readers who intend to renew would do so at the earliest moment, it would save a great deal of extra labor, and be highly appreciated. In removing names and reprinting the labels, there is always a chance of error on our part, and we respectfully renew our request that all will remit promptly who intend to.

* * *

THIS item from the *American Machinist* surprises us:

"I will call attention to the disastrous results which may follow where new and dry metallic surfaces are being fitted together. If a newly turned steel or iron shaft be slightly forced into a newly bored hole in cast or wrought-iron, the chances are that it will have to be driven out with a sledge hammer; many an unpleasant experience has resulted from such careless action. Care should be taken to remove all dust, and the surfaces should be oiled on every portion before any shaft is forced into a hole, no matter how little pressure is required to get it there. A case which brings to mind unpleasant recollections is that of fitting a face plate to a lathe spindle. The fit was a good one, and not too tight, but no oil had been placed on the cast-iron thread before the plate was screwed home; the result was the plate never came off the way it went on, but had to be cut off with the turning tool, and the thread on that spindle was never a pleasant thing to look at after this occurrence."

Mr. Thomas Almond writes this; it reminds us that we have seen men in a similar fix heat the piece slightly, when it was easily removed, without distroying anything.

CHEAP ALUMINIUM.

THE Cowles Electric Smelting Co., manufacturers of aluminium, say:

"It is our determination to immediately prepare plans for a plant that will enable us to sell the best grade of metal at not to exceed 50 cents per pound, and it is our ambition to have it displayed by the car load at the World s Fair at Chicago. I feel confident that by perfectly natural steps the price will fall lower and lower as fast as new plants can be built and the market adapt itself to the absorption of large amounts of pure aluminium, until eventually it will be selling at from $200 to $300 per ton. At these figures it will be the cheapest metal in use, next to iron and steel. When sold at 50 cents per pound, it will be in actual competition with copper at 17 cents per pound. How this can be will be realized when one remembers that aluminium has a specific gravity of 2.5, while copper is 8.9. This being the case, if the aluminium was to be used in the form of sheets, rods, or wire, a purchaser of it would receive 3.56 times as much for 50 cents as he would of copper in the same form at 17 cents. Therefore, where 100 pounds of copper would be required, something like thirty, in round numbers, of aluminium would answer. While the cost of the aluminium would be $15, that of the copper would be $17 to effect the same purpose. The electrical conductivity of aluminium, 98 per cent. fine, is about 75 per cent. that of copper. It would, therefore, take a wire of about one-third more area, to do the work of one in copper, but as it is so much lighter, motors for electric cars could be built with it having not over 45 per cent. of the weight required when built of copper. It can therefore be readily seen that with aluminium at 50 cents per pound, copper would be undersold in the electric field, a market that probably consumes two-thirds of all the copper produced. But copper is not the only metal that will be affected by cheap aluminium. At 50 cents per pound for aluminium, statesmen will cease to worry about the duty on tin, for aluminium, being about three times as light as tin, will cover three times as much surface, pound for pound, and tin, even were its qualities at all comparable with aluminium for coating purposes, would have to sell at about 16 cents, a price never before reached except in time of panic. Nickel at 70 cents per pound would become almost valueless, except for alloying purposes, for aluminium plating is as much superior to nickel as it is to tin. Nickel in our 5-cent coins would also find a rival in the more beautiful and much cleaner metal, aluminium. But it is needless to attempt any description of the things that 50-cent aluminium would accomplish, for, even at that price, it would enter the domain of iron and steel, and in a hundred to one cases drive those time-honored aids of mankind to the wall."

◆

THOMAS HOOD wrote in his "*Song of the Shirt*:"

"Alas for the rarity of Christian charity,
Under the sun,"

but if he had lived in New York he would not have found it rare. The papers at this season are full of advertisements like these:

"ANY MEN OUT OF WORK, through drink or otherwise, who will come to St. Bartholomew's Rescue Mission to-night, or any Saturday night, 158 East Forty-second Street, near Third Avenue, and begin a better life, can have an advertisement put in any newspaper, paid for by Col. Hadley, the superintendent, who will try to get him work; this mission is to help men to help themselves; open every night in the year at 7:30; good music; personal testimonies.

* * * * * *

"Mr. M. K. Jesup gave to the Children's Aid Society a large, beautiful house on Second Avenue and Forty-fourth Street, and through the kindness of Mrs. Wm. E. Dodge, Jr., we are enabled to say no homeless boy need go hungry or without a bed, and no crippled boy that is able and willing to work need beg. We have a brush shop to teach such boys to be self-supporting, and we feed and clothe them while learning free. The house is open to visitors at all times.

"Capt. W. H. MATHEWS, Superintendent,
"Boys' Lodging House, 247 East Forty-fourth Street."

COLLISIONS AT SEA.

SHIP owners and others interested in maritime matters will be glad to know that President Harrison has fixed Monday, Dec. 15, as the date upon which the new act of Congress regarding collisions at sea shall go into effect. The act was passed on Sept. 4, 1890, and on Dec. 1 James A. Dumont, the Supervising Inspector-General of Steam Vessels at Washington, issued a circular calling the attention of local Inspectors of Steam Vessels to the proclamation of the President of the United States promulgating the act, which is as follows:

"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That in every case of collision between two vessels it shall be the duty of the master or person in charge of each vessel, if and so far as he can do so without serious danger to his own vessel, crew, and passengers (if any), to stay by the other vessel until he has ascertained that she has no need of further assistance, and to render to the other vessel, her master, crew, and passengers (if any), such assistance as may be practicable and as may be necessary in order to save them from any danger caused by the collision, and also to give to the master or person in charge of the other vessel the name of his own vessel and her port of registry, or the port or place to which she belongs, and also the names of the ports and places from which and to which she is bound. If he fails to do so, and no reasonable cause for such failure is shown, the collision shall, in the absence of proof to the contrary, be deemed to have been caused by his wrongful act, neglect, or default.

SEC. 2. That every master or person in charge of a United States vessel who fails, without reasonable cause, to render such assistance or give such information as aforesaid, shall be deemed guilty of a misdemeanor, and shall be liable to a penalty of $1,000 or imprisonment for a term not exceeding two years; and for the above sum the vessel shall be liable, and may be seized and proceeded against by process in any District Court of the United States by any person, one-half of such sum to be payable to the informer, and the other half to the United States.

SEC. 3. That this act shall take effect at a time to be fixed by the President by proclamation issued for that purpose.

This act is so plain in its language that misunderstanding it is impossible.

◆

IN overhead steam heating the method now approved is to run four rows of $1\frac{1}{4}$ inch pipe 16 inches from the ceiling, in ratio of one lineal foot of pipe to 70 cubic feet of air. This is a rule of thumb, but is applicable to nearly all conditions of factory heating. The ratio is larger than will be needed in spinning rooms or cotton mills, and probably less than desirable in weaving rooms, especially in the northern part of New England. This rule is based on the use of exhaust steam, and, when deficient, can be supplemented by using direct steam in the morning. The method of the transmission of heat overhead was shown by experiments in a large machine shop. Before the steam was let on the pipes were smeared with oil, and when the pipes were heated the smoke and heat diffused itself uniformly in all directions. This showed that the air was heated by direct radiation and not by absolute convection.

◆

THE '*Say When*,' formerly one of Norman Munro's numerous steam yachts, is now on the lakes, and seems to have astonished the natives, for they credit her with all sorts of impossible performances. When here, the '*Say When*' was not a fast boat except for a short spurt; her wind gave out on long runs, or in other words she could not keep steam She was sold to a Mr. Beckwith by Mr. Munro, and again sold by Mr. Beckwith, in a short time, to her present owner.

A FARCE IN ONE ACT.

SCENE.—The counting-room. The proprietor seated at desk rubbing his forehead and trying to make a a loss come over on the right side of the ledger. Enter the bookkeeper, R. U. E.

"Mr. Jones, I find that the office boy, Thomas, whom you rescued from the gutter, has been stealing postage stamps for the last ten days."

Proprietor.—"Ah ha! He has eh? The scoundrel! that accounts for this balance on the wrong side. How many has the wretch stolen?"

Bookkeeper.—"Well, I don't exactly know, but I should say several. I have missed a sheet of twos, and about ten ones; I think he must have bought cigarettes with them.

Proprietor (*excitedly*).—"Have him arrested at once, haled before the Alcalde, and confined in the deepest dungeon beneath the castle moat. Steal my postage stamps, will he! How is it possible to make any money in business with such base caitiffs around?"

[*Bookkeeper retires to carry out the sentence*].

Enter the Engineer, L. F. E.—"Sir, the boiler blowcock is so badly worn that I cannot keep it tight any longer. We need a new one, for the one we now have leaks about a gallon a minute.

Proprietor, (*bouncing excitedly from his chair, his hair on end, his hands extended to heaven. He shouts*): "New blowcock! Good Heavens! Your extravagance will ruin me. Last week you demanded a new oil can; next week you will probably ask for a new wrench, or something equally foolish. To-morrow you will require oil, coal, what not. How the devil do you suppose I can run a business with such constant demands? Go back to your department, sir, and mind your own business. I will not buy you a new blowcock; learn to do without such unnecessary things! If I listened to your demands I would soon be bankrupt."

Engineer retires, soliloquizing.—"Good Gad, was there ever such a boss as that! The office boy steals a dollar's worth of postage stamps and will probably be hung, while the boiler blowcock steals two dollars' worth of coal daily, and the boss wants my life because I tell him of it!" [*Shakes his head in hopeless contemplation.*]

Proprietor, still fuming.—"New blowcock! I got the best of him, anyway."

◆

As to what are and what are not raw materials a trader would like information.

I would like a solid definition of the words "raw material" and "finished product." What is the difference? Is white lead, which is certainly a raw material to the house painter, really a finished product? It is to the manufacturer. Is coal a raw material? Cotton wool is a finished product to a medical man; to a spinner it is raw material. Is wheat a raw material? To the farmer it is a finished product. Is flour a raw material? It is to the miller, beyond question, a finished product. What is the broad distinction between finished products and raw materials, or is there any broad distinction?

◆

IN some experiments recently made, Professor Denton, of Stevens' Institute of Technology, Hoboken, had occasion to test a small vertical engine 3"×5". As this is a very common size for steam launches, it is of interest to know the power developed under the following conditions: Revs. per minute, 200; steam above atmosphere, 59.8 lbs.; mean effective pressure, 52.99; total horse-power, 3.75; power lost by friction of parts, 16.35 per cent. of the total.

◆

THE people of the United States annually require 3,000,000,000,000 envelopes, or about 50,000 per capita, says a statistician.

[We don't seem to get much satisfaction from this information.]

◆

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VOL. XX. NEW YORK DEC 20, 1890. No. 13.

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1881—1891.

THE present issue closes the current volume and the tenth year of the publication of THE ENGINEER. In reviewing the decade we find that it has been—to us—full of stirring incidents. No man or set of men can possibly foresee the amount of discouragement, reverses, and disappointment they will have to encounter in establishing a new paper, unless they have had previous experience in the same line. The very class to whom papers are often addressed refuse to countenance or support it, and publishers are often obliged to go outside of and abandon their original prospectus in order to succeed at all. Why these things are so it is not our purpose to inquire; we have no concern with the affairs of others, but are very much interested in our own. When THE ENGINEER was projected, it was upon the strength of a wide personal acquaintance all over the country, more or less engineering experience personally, and very much more moral sand, so to speak, than capital. At the end of ten years we find that none of these resources have failed us. The original stock of personal friends has been increased many fold by other friends who have interested themselves in the objects for which THE ENGINEER is published; the capital has likewise increased, while the sand has accumulated in such volume that we have some to spare. Competition has also increased very largely. Where there was one trade paper ten years ago there are a dozen now, all clamoring for a hearing—chiefly, let us say, from advertisers. This last is the object of the existence of many so-called technical papers. Despite all these obstacles in its path, THE ENGINEER has steadily made its way and obtained a position and status which we are proud to say is second to none in this country.

Making no pretensions to a fictitious circulation, there is no trade paper which has a wider representation, covers more territory, or reaches a higher class of readers. We do not appeal to the unthinking, but to those who are desirous of something of more permanent value than the "Mike" and "Jim" class of trade literature. We shall continue in this course so long as THE ENGINEER exists, because this is our field of operations.

We only briefly advert here to the change which has taken place in our firm since it was established—for this reason—that the previous lines assume that the success of THE ENGINEER has been due to the senior editor only. This would not be true. How much we are indebted to the man who has been called away we only know. In dark days, when every avenue was closed, and the end seemed at hand, then it was that EGBERT P. WATSON, JR., worked the hardest and was the most sanguine. Discouragement did not daunt him; nothing shook his belief in ultimate success; he worked with hand and heart, and it is due to him now to acknowledge for the last time his magnificent courage and spirit. Mere words are inadequate to this subject, so we say no more.

To the other friends of THE ENGINEER who have contributed so largely to its success, with hand, pen, and hearty encouragement, we could say much that would not sound well, perhaps, to other ears in these prosaic pages, but we no not forget their aid, past and present.

To the thousands of readers everywhere we also return thanks for their support, and hope that in their material affairs and concerns they may be prosperous. The current year has brought varying fortunes to many, but let us all, with renewed courage, look forward to 1891, and in that spirit we wish one and all:

"A Merry Christmas and a Happy New Year."

◆

IN the six-inch rifled gun the projectile is making 250 revolutions per second at the moment of leaving the muzzle.

GOVERNMENT SCHOOLS FOR ENGINEERS.

IT is a curious fact that while the use of steam is increasing yearly in navigation, there are no schools for engineers where the A B C of the trade can be learned. The government still keeps up its school-ship, '*St. Mary*,' teaching young men to be able seamen, which A B's are then shipped on board of ironclads or cruisers where there is not as much cloth above deck as there is upon an old woman's clothes line. Young men are taught to hand reef and steer, stow hammocks, and learn navigation and seamanship generally, all at Uncle Sam's expense, but there are no such opportunities for young men to learn to be engineers gratuitously. Why are there not? We do not know. There is no lack of technical schools which purport to fit young man to be engineers, that is to say superintending engineers, in process of time, but all these begin the course at the wrong end. They reverse the natural order of things. A young man who can use logarithms, but cannot use a screw wrench, who knows how to solve problems of all kinds, but cannot make a pasteboard, or putty, or a rubber joint, is of no earthly use in an engine room, except, possibly, to ornament it, or for persons who have work to do to fall over in dim passages. In an engine room the work comes first, and the problem comes after. If the ship is to go the engines must go, and go as fast as they can. They never stop to think or dispute about this man's or that man's theory of cylinder condensation, but they keep on turning if everything is "ship shape and Bristol fashion." If it is not technical, school training is of no use. We want engineers first, and scholars afterward; the one may be embodied in the other, and should be, to make the perfect man, but first and foremost we want the intuitions and perceptions of the working engineer, and the theories and deductions of the observer subsequently. We can get safe to port without the latter, but the engineer we must have. It sounds fantastic to use such expressions, but the facts are that engines tell things to working engineers that they will not impart to students, and this is only another way of saying that skilled workmen can detect causes of disaster and disasters before the catastrophe occurs; while the student passes an unusual noise as of little importance; he cannot hear that there is a follower bolt loose until the piston jumps out on the floor through the cylinder head and shows it to him. Why are not seamen apprentices taught navigation first, and how to splice ropes afterward? Simply because the authorities know that sailors are made by the opposite course.

We want a national school for engineers, where the course of training shall proceed from the less to the greater. We want young men to begin at the bottom, where their grandfathers began, and go up to the top. We want them to learn how to make joints, to know how much strain a $\frac{5}{8}$ths bolt and nut will bear without stripping. We want them to know how to grind valves to their seats, pack stuffing-boxes, keep dirt out of bearings, to fit brasses that are improperly fitted, or bed down nuts that do not seat square. We want them to know how to make pumps work when they don't want to; in short, we want them to have all the trouble, fret and annoyance that steam service can give them, for the fruit and blossom of all this experience is a trained engineer. We shall never make this man in a school of the regulation pattern. Life is too easy. There is too much figuring up nothing, and making pretty drawings of nothing. The coal bunker is a good deal better place for a young man than a drawing-room if he is ever going to be an engineer. After he has had some fun in the coal hole let him into the drawing-room. We might as well try to make generals out of lawyers as to make engineers out of students. In modern warfare the engineer is actually of more value than the captain or commander. The captain may be killed before the ship gets fairly into action, but the next in rank can take the ship out of action at the least, but if the engineer corps fails there will be no chance to take the ship out of action; the enemy will do that promptly.

The Government should give ambitious young American men an opportunity to learn to be engineers of the old school type. The new practice ship now building is a step in this direction, possibly; but it depends mainly upon the course of tuition adopted whether such practice is merely a sea picnic, or the stern discipline of every-day life on commercial vessels.

◆

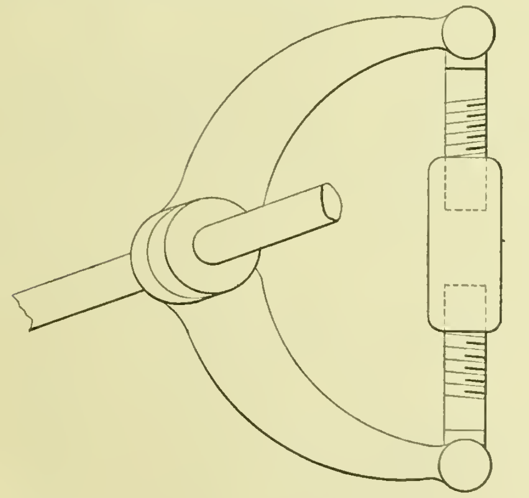
THE MANAGEMENT OF A CORLISS ENGINE. No. 2.

By Charles D. Thurber, Biddeford, Me.

In my last paper nothing was said about the quality of steam produced. This is a point too frequently overlooked by engineers. If you have upright boilers, which moderately superheat the steam, you are all right in this respect, but with horizontal tubulars there is a strong probability of there being too much moisture in the steam. This can be determined by the calorimeter test, which has been fully explained in engineering papers. I do not consider that high evaporative results from horizontal boilers are of any value, unless accompanied with the calorimeter test, showing that the steam produced is quite dry.

This tendency of horizontal boilers to furnish wet steam is the reason why I prefer well designed uprights when high steam is required for compound engines. One gauge of water while engines are running, and continuous feed, will prevent an excess of water passing away with the steam in boilers of good design. I depend entirely on gauge cocks, having no glass gauges whatever. These boilers in my charge are over 10 years old, and, all told, there are over 22 hundred tubes; not one of them has ever leaked from any cause.

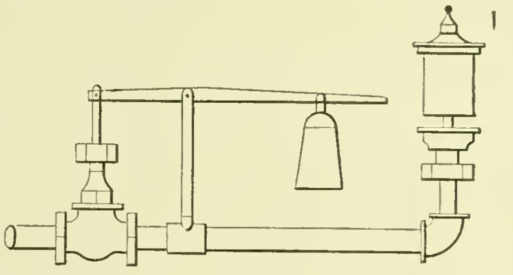
We are all aware that properly covered pipes contribute largely to the economic results. I have found that hair felt, with asbestos mill board next to the pipe makes a good covering, but for a short time only. The asbestos does not prevent the felt from burning on top of pipe; in 6 months it will be found nearly, if not quite, destroyed, and on the bottom it will be hanging loose from the pipe. On flanged pipe I use one inch each of Nos. 1 and 2 asbestos cement, and outside of this, one inch of hair felt. This brings the covering out even with the flanges; then all is covered with heavy cotton cloth, and for the boiler room it is whitewashed; in the engine rooms it is covered with a jacket of Russia iron, and brass bands to break joints.



In regard to the size of steam pipe to the engine, I would say do not be governed by the capacity of opening into the cylinder or the valve furnished by the builders. The high piston speeds now so common require larger pipes, and if they are long, considerably larger diameter should be used. The Corliss cross compound engine, of which I am about to write, has cylinders 22″ + 40″ by 60″ stroke, and runs 60 revolutions per minute. The throttle is 7″ and the steam pipe about 200 feet long. I enlarged from the throttle with a short piece of cast-iron pipe up to 10″, and the balance is made of 10″ boiler tubing in long lengths, with heavy cast-iron flanges riveted on. All bends are made of copper. Such a steam pipe as this is far more reliable for high pressures than cast-iron or common wrought pipe with screwed joints.

The cylinders of this engine are proportioned in this way on account of the unusual amount of steam required for use in the mills, which is taken from the receiver. Besides seven slashers (which turn off something over ninety thousand pounds of yarn each week), there are eighty vapor pots in the weaving rooms, all of which are supplied from this source. The usual pressure in receiver is five pounds. This engine has been running two years, and is connected to ten water-wheels of 180 h.p. each. There are no regulators on the water-wheels, the engine governor controling the speed of all. From this and other causes, the load is quite variable, and with full river the engine is sometimes underloaded.

As left by the builders, I at first had trouble to maintain an even pressure in the receiver, and furnish steam for use in the mills, as the point of release on both cylinders was determined by the governor, and no way was provided to change the cut-off on l.p. cylinder. This would be correct under certain conditions, but not so here, as the amount of steam taken from the receiver is subject to considerable variation, and this, together with changes in power required, made it necessary to make an alteration. The regulator shaft connecting one cylinder with the other was cut in two and connected as shown by sketch.



By turning the nut between the levers to the right or left, the l.p. cylinder is made to take more or less steam, as the case may be, and at the same time it is controled by the regulator.

During a large part of the time the l.p. cylinder is made to cut off somewhat earlier than would be the case if a low steam consumption by this engine alone was desirable. It is the total coal used that interests the stockholders. During the season of low river, when other engines are furnishing the steam for use in the mills, and this engine is running under favorable conditions, the coal consumed during a test of one week, including that used for banking fires at night, was 1.73 lbs. per h.p. per hour. The exhaust steam from the duplex feed pump on this trial was used to heat the feed water for another set of boilers than those from which the engine steam was taken. As running at present—with an overflowing river, and steam taken from the receiver for the mills, as mentioned above—the coal used per h.p. per hour varies from 1.9 to 2.1 lbs.

The variations in load, sometimes caused the receiver pressure to fall quite low, unnoticed by the engineer. This made bad work and loss in the slasher room. To prevent this loss, and give us timely notice, I connected a small whistle to pipe leading to slashers, as shown by sketch.

A pressure of 5 pounds holds the valve down to its seat,, but at 4½ pounds the weight lifts the valve, and blows the whistle before there is any cause for complaint in the mill, and the engineer has time to make the proper adjustment of the cut-off on the l.p. cylinder, or open the by-pass valve into receiver.

The air pump is the regular Corliss pattern, 34 in. by 12 in. stroke. A part of the overflow, with the water of condensation from the receiver, is returned to boiler room. A ¾ in. pipe from the overflow leads up to the engine room, into which a thermometer is inserted, and returns below to condenser, thus showing temperature of overflow water at all times.

A small pipe, admitting a little air into the channel way, effectually stops the pound that is so common with this kind of air pump.

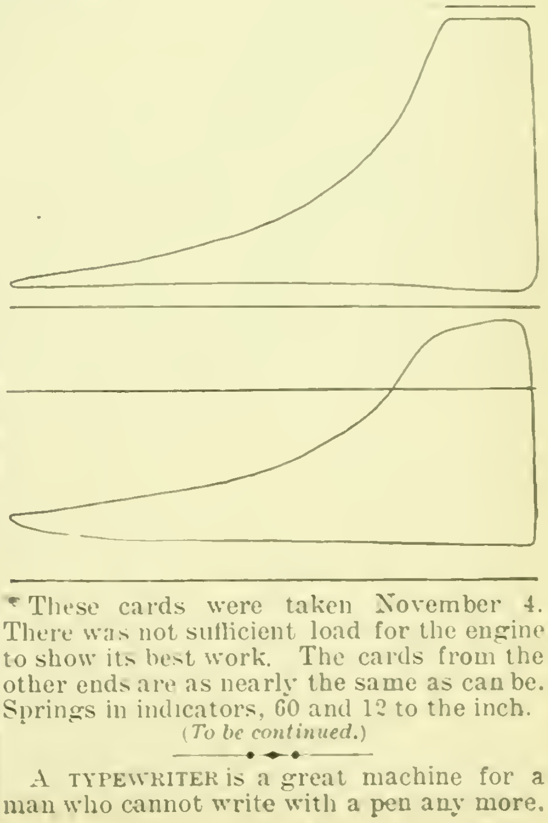
As the machinery in the mills is run at as high speed as possible, it is very important that the engine regulation should be as perfect as it can be made.

This engine should make a full revolution each second; if it should fall short of $\frac{1}{100}$ of a revolution in each second throughout the day there would be a very perceptible diminution in product. If it should fall short this much during an hour, it is so much lost; it should not be made up in the next hour.

The Corliss governor, unaided, will not regulate as closely as it is desirable to run in a cotton mill.

I have found the Gale governor attachment to be a great help, but even this useful and neat-looking little device needs some attention if a strictly uniform rate of speed is desired, suppose the Moscrop recorder is an excellent thing to show the variations in the speed. A good many years ago, before I ever heard of a "Moscrop," or other device for this purpose, I made a little machine, which is still doing splendid service. On the shaft of the air pump rocker is fixed a small adjustable arm carrying a ratchet, which picks one tooth at each revolution of the engine in a ratchet wheel of an equal number of teeth, with revolutions desired by the engine in one minute. On the shaft of this ratchet wheel there is a pair of miter gears, by which this movement is taken up into the engine room, where, at a convenient place, there is a clock dial with suitable train of gears to run a minute and "second hand." After the engine is started, the hands on this dial are set to exactly agree with the engineer's time. After an hour's run, if there is a gain or loss of one second, which means with this engine one revolution, it is easily detected and corrected. This dial makes no record of the revolutions for yesterday or last week, but as it enables us to run just right all the time, it is very satisfactory.

The engine register or counter shows each day the number of revolutions, and this is recorded for each engine, with all other matter of interest, in a logbook kept for this purpose.



* These cards were taken November 4. There was not sufficient load for the engine to show its best work. The cards from the other ends are as nearly the same as can be. Springs in indicators, 60 and 12 to the inch.

(*To be continued.*)

◆

A typewriter is a great machine for a man who cannot write with a pen any more.

Foreign and Domestic Trade Literature.

THE PROCESSES OF STEAM IN ITS DEVELOPMENT OF POWER BY MEANS OF A STEAM ENGINE.*

By Chief Engineer Isherwood, U. S. N.

The water of liquefaction deposited on the interior surfaces of the cylinder is only made possible by the variations in temperature of the metal of the cylinder, caused by the similar variations in the temperature of the expanding steam; consequently when the variation of the temperature of the metal of the cylinder is rendered impossible by the employment of a steam jacket capable of maintaining the metal of the cylinder at the constant temperature of the boiler steam, there is no deposition of water of liquefaction on the surfaces of the cylinder, and the losses of heat are confined to what belong to the molecular actions of the steam alone.

The losses by the interaction of the metal of the cylinder with the heat of the steam are preventable by the employment of a steam jacket, but not the losses by the molecular action of the steam.

The entire losses of heat, to which the so-called "cylinder condensation" is due, are caused by the use of the steam expansively, and are greater with greater measures of expansion.

As regards the measure of expansion with which steam can be most economically used, a limit is, therefore, soon reached in practice. depending on the boiler pressure, the back pressure against the piston, the pressure required to work the engine *per se*, and on the use or non-use of the steam jacket; when the losses caused by the expansion neutralize the gain due to the expansion, the practical limit of expansion is attained, and, if it be carried further, loss will be experienced.

Thus far, no reference has been made to the obvious loss of heat from a cylinder by external radiation, in order not to complicate the essentials of the problem by mingling non essentials with them. The loss by radiation can be reduced by suitable coverings of non heat conducting materials until it becomes nearly insensible, and such should always be the case with practical steam engines.

Whatever liquefaction of steam due to external radiation there may be in a cylinder, will take place during the entire stroke of its piston, but, of course, will be greater at those parts of the stroke where the pressure is greater. This water of liquefaction will be revaporized in whole or in part under the lessening pressures in the cylinder due to the expansion of the steam, and the resulting steam will be utilized as pressure on the piston, but any part of this water that may be vaporized during the exhaust stroke will pass to the condenser as steam, without doing work on the piston. The heat of vaporization of this latter part will be wholly lost.

The cooling of the metal of the cylinder by this abstraction of heat, caused by the revaporization of the water of liquefaction due to the external radiation, has to be restored by heat taken from the steam entering from the boiler, consequently there will be a liquefaction additional to those already described in the cylinder between the commencement of the stroke of the piston and the point of cutting off the steam, equivalent to the heat lost by radiation.

The greater the loss of heat by steam liquefaction in the cylinder, the greater, proportionally to power developed by the engine, will be the work done by the air pump in discharging the greater quantity of mingled injection water and water of steam liquefaction, and of air and vapor, because the greater will be the weight of steam used per unit of time per unit of power. Also the greater will be the work done by the feed pump.

(*To be continued.*)

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*A Lecture delivered before the Sibley College of the Cornell University, Ithaca, N. Y., December 13, 1889.

THE NICKEL-STEEL ALLOY.

Secretary Tracy has received a report giving the results attained at the Homestead Steel Works of Carnegie, Phipps & Co., near Pittsburg, of the first attempt made in this country to produce nickel steel, and he is very much gratified at the success attained. The experiment was made by Carnegie, Phipps & Co. for the Navy Department, and the results seem to have fully justified Secretary Tracy and the Ordnance Bureau in undertaking the development of nickel-steel. In fact, if such results as were attained in this experiment can be uniformly produced, it is believed the business of making steel will be revolutionized, especially as at this time Dr. Emmens, the chemist, claims to have perfected a method of obtaining ferro-nickel—especially adapted for making nickel-steel—from the ore at greatly reduced cost.

The object of the experiment at the Homestead Works was to produce, as nearly as possible, the alloy used in the nickel-steel armor plate made at Le Creusot, France, and recently tested at the Annapolis proving ground with such good results. That this was done is evident from the chemical tests, which show that in the French plate the percentage of nickel was 3.32, while in the Homestead metal it was 3.16. The experiment at Pittsburg was not with a small quantity of of metal, on such a scale as might be conducted in a laboratory, but was with a five ton heat in a Bessemer converter. Part of this heat was rolled into three-quarter inch plates, from which a number of test specimens were cut.

Two of these pieces were tested lately and gave surprising results. The elastic limit was, respectively, 59,000 pounds and 60,000 pounds. The ultimate tensile strength was 100,000 pounds and 102,000 pounds, repectively. The elongation was 15½ per cent. in each specimen, and the reduction of area at fraction was 29½ per cent. and 26½ per cent., respectively. These figures show that the elastic circuit and ultimate tensile strength were raised by the nickel alloy to almost double the limits reached in the best grades of boiler plate steel, and the elongation was reduced to a scarcely appreciable extent. Thus the desirable qualities of hardness, strength, and elasticity were combined in a remarkable degree in a metal of great ductility. These results were attained in the first attempt, and with steel made by the Bessemer process. It is believed that better results can be obtained even now by the open-hearth process, and it is reasonable to suppose that, with more experience, still further improvements will be made.

It is impossible to foretell what will be the ultimate effect of this development of nickel-steel. Secretary Tracy is very enthusiastic on the subject, and is naturally gratified at being one of the pioneers in taking up the new alloy, which was first used as a material for armor plates, but now promises to enter into the construction of not only armor plates, guns, and projectiles, but the hulls and engines of ships, and if the cost of nickel can be reduced, it is believed it will be adopted for all purposes where a high grade of steel is at present used.—*N. Y. Times.*

One of the principal difficulties with the use of steel for the hulls of ships has been that it corrodes rapidly in the salt water, and barnacles and other sea growths adhere to it closely, thus requiring the bottom to be cleaned and painted at short intervals. Some recent experiments in Germany show that the new alloy is much freer from both corrosion and fouling. Secretary Tracy has directed that some of the plates made by Carnegie, Phipps & Co. be submerged, together with some ordinary steel plates, so that these qualities of the metal can be tested.

Investigations made by the Ordnance Bureau of the Navy Department show that the supply of nickel is practically inexhaustible, by far the greatest quantities of it being found in the Sudbury district in Canada.

Dr. Emmens, at his works near Pittsburg, is now engaged in reducing by his new process a considerable quantity of the nickel matter recently purchased by the Navy Department for experimental purposes. If he is as successful in this as he hopes to be, the cost of the metal will be much reduced.

Within the next ninety days Carnegie, Phipps & Co. expect to deliver to the Navy Department their first test armor plates, of which some will be all steel and others nickel steel. These plates will be tested in comparison with the two French plates fired at in the recent armor trials. Their armor-plate plant is now complete, with the exception of erecting the large cranes for handling the plates, the hydraulic press for shaping them, and some special machines for trimming and finishing them. Their process will differ from that adopted by the Bethlehem Works in that the plates will be rolled in a specially constructed mill of great power, instead of being forged. They expect to begin the delivery of armor under their contract by or before next June. The Bethlehem Company will not be ready so soon, owing to delay in getting its mammoth 125-ton hammer set up.

◆

It is conceivable that men may write so much, and deduce so much from their own premises, that at last they consider themselves as the only original discoverers and authority, and they write from that standpoint wholly: "In my writings," says an observer of this type, "I have invariably," etc., etc. This sort of conclusion is very common, but it is not satisfactory to persons of a skeptical turn of mind, who like to consider for themselves.

◆

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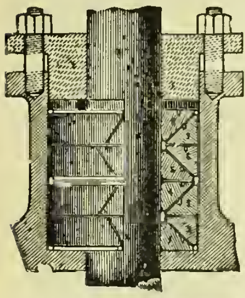

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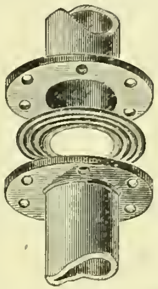

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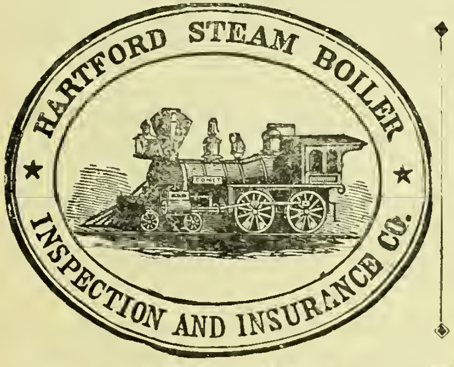

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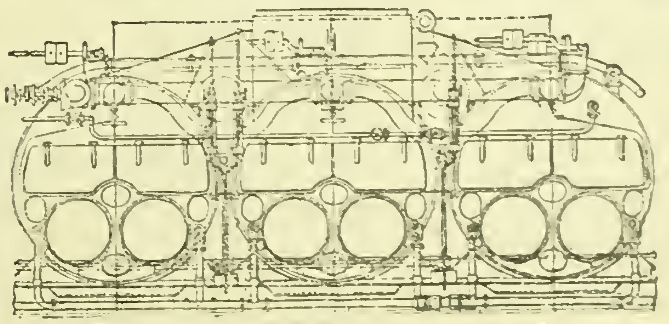

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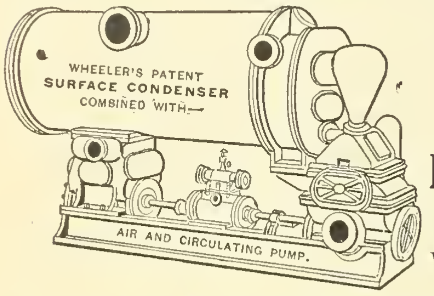

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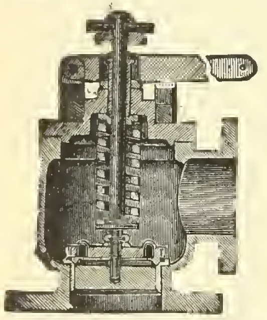

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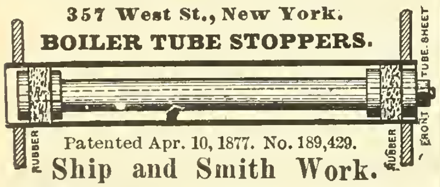

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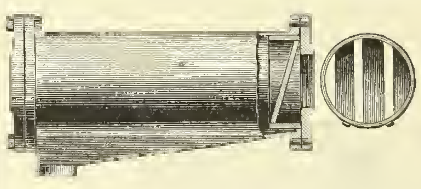

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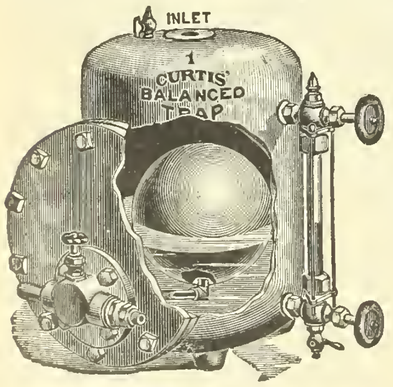

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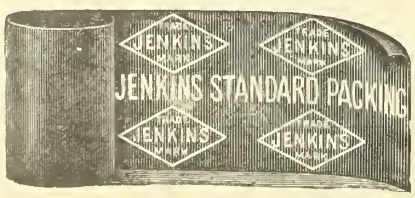

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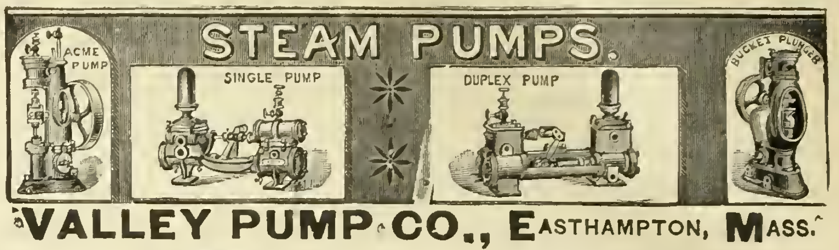

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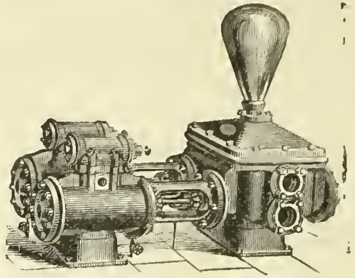

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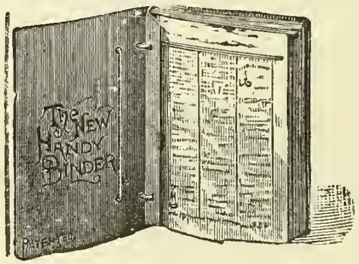

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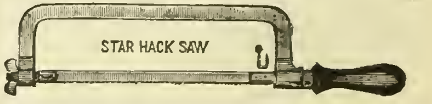

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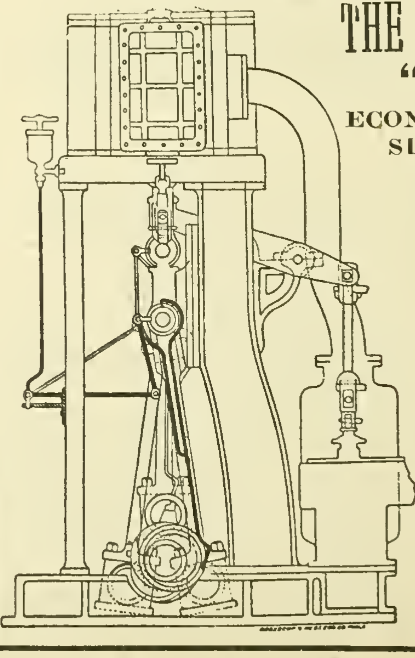

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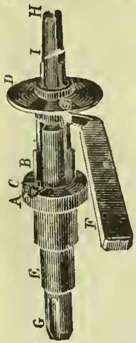

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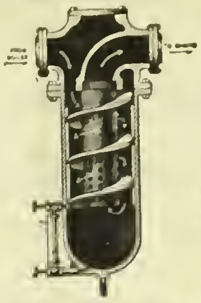

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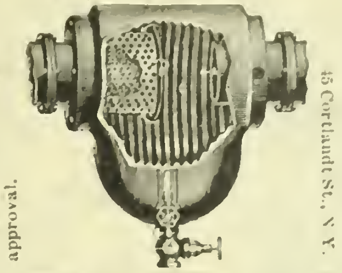

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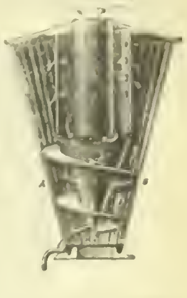

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SIR:—We have respectfully to report, that in accordance with the endorsement on the letter of the Bureau of Steam Engineering, dated July 10th, 1889, and numbered 1964 J. J., we have tested the Lubricating Balls made by the Colgan Manufacturing Co., by using them for the internal lubrication of the Machine-shop Engine of this Yard, during all the working days since the 24th of December last, until the 15th of the present month, or forty-five days. For the first five days, four balls per day were used; in the next ten, three per day; and since then, only two per day. They were fed to the steam chest, a quarter of a ball at a time, through a common grease cup, having a cock below it and covered with a screwed cap. These balls are put up for transportation in wooden boxes that hold a gross each, the outside dimensions of the boxes being ten inches by ten, by seven and a quarter inches deep. They are, therefore, easy to handle and to stow and care for on shipboard. Each ball is wrapped in tissue paper, to prevent adhesion under moderately high temperatures. They liquefy at about 110 F. They have no objectionable odor, either in the solid or liquid state. We have the assurance of the manufacturer, in which he expresses a willingness to support by affidavit, that they contain neither animal or vegetable matter. They are sold at five dollars per gross. On the 16th instant, the interiors of the cylinder, valve chest and heater into which the engine exhausts, were examined. All the wearing surfaces were found in excellent condition, bright, smooth and clean. Nowhere in the cylinder or chest was there any accumulation of grease or dirt. The heater had not been cleaned for a long time, but there was no appearance of recent deposits of grease. The anti-frictional value of this lubricant could not be established by this method of test, but, to the unaided senses, the appearances were in its favor. It would seem, therefore, that, at a cost of less than seven cents for and eight-hour day, the internal wearing surfaces of a twenty-inch cylinder, including a main and cut-off valve (both sides), the piston of which, actuated by steam of an initial pressure of forty pounds, had a speed of about 540 feet per minute, were well and efficiently lubricated for the time of the test. We, therefore, respectfully recommend these Lubricating Balls for purchase and use in vessels of the Navy wherever they are required. Very Respectfully,

CHARLES H. LORING, *Chief Engineer and Member of the Board.*
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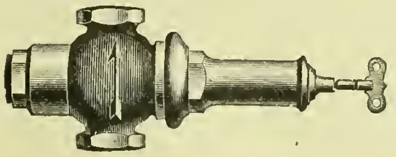

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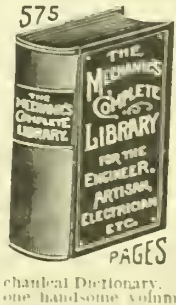
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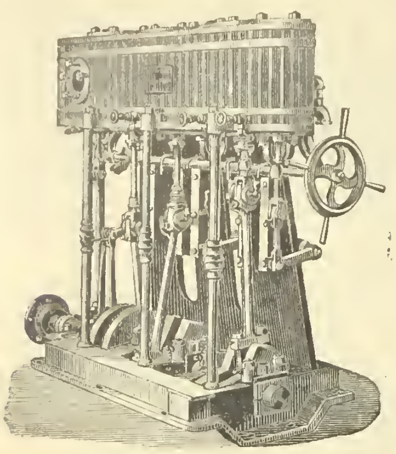

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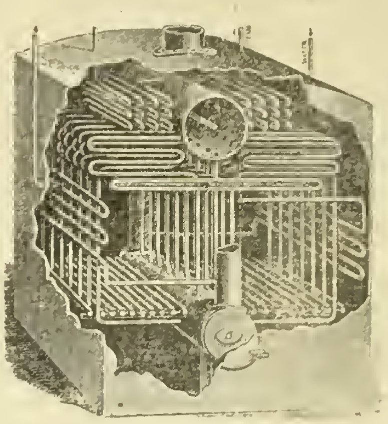

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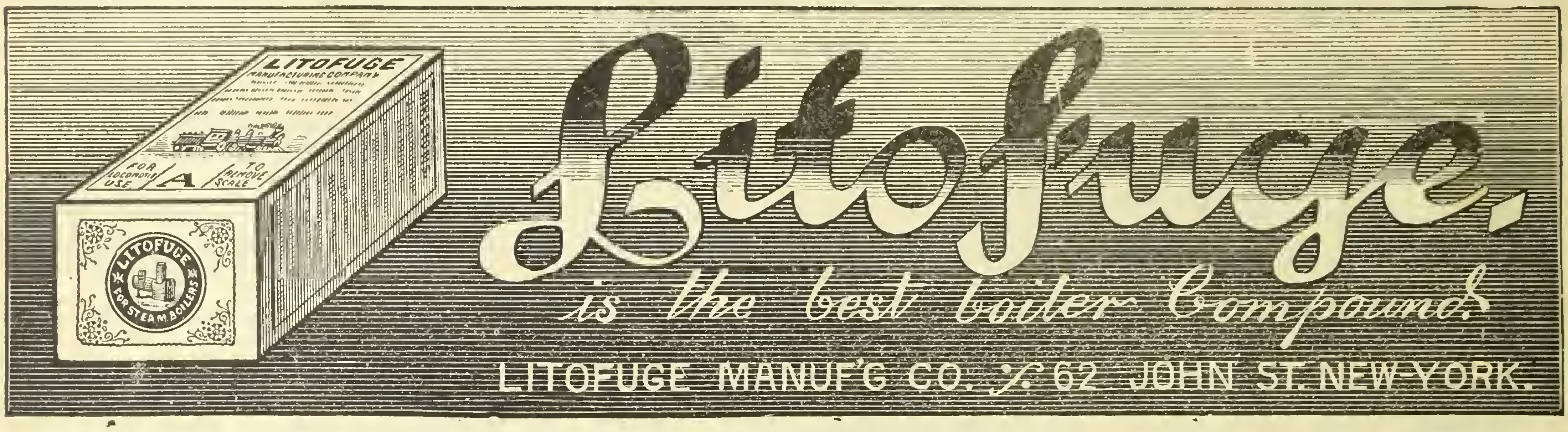

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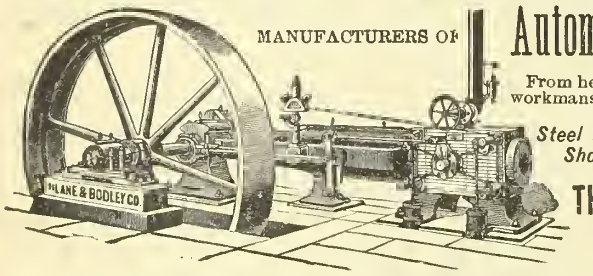

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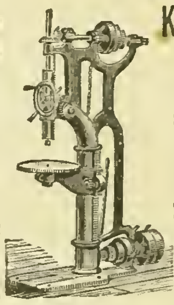

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